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Alkalinisation of Urine in Patients with Infections of the Urinary Tract

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

Urinary alkalinisation is a common practice in the management of dysuria in patients with urinary tract infection. Although there is wide empirical experience with this approach, scientific literature is limited. The mechanisms by which modifying urinary pH reduces dysuria are still poorly understood. This brief review examines the theory and practical implementation of urinary alkalinisation in patients with infections of the urinary tract and dysuria.

Keywords: Urinary alkalinisation; urinary tract infection.

1. BACKGROUND

Urinary tract infections (UTIs) are one of the commonest forms of infection and are frequently encountered by both hospital and community physicians [1,2]. UTI is an umbrella term describing infection anywhere in the urinary system [3]. Cases typically manifest with distressing symptoms such as a frequent urge to urinate, difficulty initiating voiding and pain on voiding. Dysuria is the term for painful urination and is usually described as burning, stinging or itching in nature [4,5].

Urinary alkalinisation is common practice in the management of UTI for its ability to provide symptomatic relief of dysuria [6-8]. There is no single definition of urinary alkalinisation however

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it may be considered as a method of manipulating urinary pH such that pH rises following administration of alkalising agents [9]. Some clinicians endorse a urine pH of greater than 7.5 to be the target of alkalisation [9]. Although supporting scientific evidence is relatively limited, an abundance of empirical experience recognises alkalinisation as an effective means of alleviating dysuria [3,8,10,11].

2. MECHANISMS OF DYSURIA IN UTI

Complex mechanisms and pathways contribute to the pathophysiology of pain. The pathogenesis linking dysuria and UTI is not clearly established.

Dysuria is partly explained by inflammatory mediators of pain which are produced in response to infection [12]. Additionally, elements of the inflammatory cascade are hypothesised to indirectly increase C-fibre afferent sensitivity to noxious stimuli. This hypersensitivity results in excessive pain perception in the setting of urinary system infection [13,14].

Urine acidity itself is also widely believed to contribute to the sensation of dysuria. The pH of infected tissues is usually lower than that of normal non-infected tissue surrounding it [15]. This trend is also generally true for urine although it is an inconsistent finding [3,16,17]. Lower pH elicits greater pain because various pain receptors and afferent C-fibres in the bladder wall are stimulated by hydrogen ions, which are more highly concentrated at greater acidity [14].

3. MECHANISMS OF URINARY ALKALINISATION FOR DYSURIA

Urinary alkalisers are salts that produce alkaline aqueous solutions. When suspended in water agents such as sodium bicarbonate and sodium citrate react to produce hydroxide ions, which are basic anions capable of accepting and neutralising protons like hydrogen ions. The purpose of alkalinisation is to neutralise acidic urine and thereby interfere with the genesis of pain induced by a low pH environment. This theory helps to explain the relief of dysuria experienced by some patients with this treatment [18,19].

Neutralisation of urine pH does not explain the improvement in dysuria for all cases. In many patients urinary pH is not altered by UTI [17,20]. Infected urine is not invariably more acidic than normal urine, and in fact is occasionally alkaline.17 How dysuric patients derive benefit from alkaliniser therapy in such circumstances is not known.

4. EFFECT OF URINARY ALKALINISATION ON ANTIMICROBIAL ACTIVITY

Urinary pH has important consequences for natural immune mechanisms. In normal individuals urine pH ranges between 4.5 and 8, and on average between pH 5 and 6. The phagocytic function of neutrophils operates most efficiently within a narrow pH range which is relatively alkaline compared with typical urine [3]. Neutrophilic oxygen metabolism is hindered by lower pH environments [15]. In one small controlled experimental study, phagocytosis by neutrophils was considerably less proficient in a urinary pH of 5.8 compared with subjects with urine pH of 6.4 [17]. Although the literature is not extensive most data has illustrated a threshold between pH 5 and 6 as the minimum urinary pH necessary for effective neutrophilic activity [21].

Urinary alkalinisation does not reduce antibiotic efficacy in UTIs [22]. Indeed several experimental studies have found the antimicrobial activity of a number of antibiotics to be enhanced by higher pH (see Fig. 1). An exception is the cephalosporin group whose efficacy is theoretically reduced by an alkaline environment. Alkalinisation has been known to diminish the antibiotic potency of tetracyclines, however these represent an uncommon treatment choice for UTI [10]. Nonetheless, changing antibiotic potency of any sort as a consequence of varying urine pH has not been thoroughly demonstrated in practice [16]. The interactions between alkalising agents and antibiotics are largely untested clinically and the role of pH manipulation as an adjunct therapy to antibiotic use for UTI is undetermined.

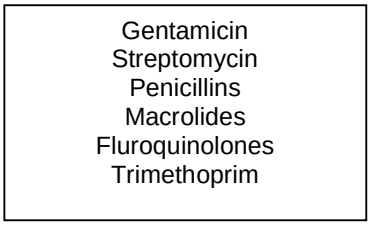

Fig. 1. Antibiotics with activity enhanced by urinary alkalinisation [10,16,20]

It is worth noting that regular intake of urinary alkalinisers does not prevent UTI recurrence [2].

5. URINARY ALKALINISATION IN PRACTICE

A trial of urinary alkalinisation is recommended to relieve dysuria in patients with UTI [22,23]. It should not reduce antibiotic efficacy nor extend the duration of illness. Alkalinisers can be administered daily and titrated to response until symptoms resolve. Commonly available options include sodium bicarbonate, sodium citrate and potassium citrate, which can generally be purchased without prescription (see Table 1). They are administered as capsules or powder diluted in water, however specific products vary by country.

Table 1. Commonly used urinary alkalinisers [24]

Product choice	Suggested regimen
Sodium bicarbonate capsules	Dose according to response. Use 1-6 capsules (840 mg each) daily until symptoms resolve. Give in single or divided doses.
Combined sodium bicarbonate and citric acid effervescent granules	Dilute 1-2 sachets in water and consume 3-4 times daily according to response. Use until symptoms resolve.

Alkalising agents must be used with caution in patients taking fluoroquinolones. Treatment effectiveness is unchanged however there is a propensity for crystalluria with this drug combination. Alkaline urine renders ciprofloxacin and other fluoroquinolones less soluble therefore promoting crystal formation [10,22].

Urinary alkalinisers containing sodium must be used carefully in patients who require sodium restriction. The daily sodium content with typical use of a sodium-based agent often exceeds a normal daily salt requirement. This may be unsuitable, for example, in select patients with heart or kidney failure [10].

6. CONCLUSION

Urinary tract infections are prevalent in the medical setting. Dysuria can be a troubling feature of UTI but symptomatic relief is often achieved by urinary alkalinisation. Its mechanism of action is not fully established. A reduction in excessive pain nociception induced by acidity presumably plays some role. Alkalinisation of urine also appears to alleviate dysuria in some patients regardless of urinary pH, although its efficacy at different pH ranges has not been compared in randomised trials. It is not a curative measure in itself however may be an underutilised supplement for the treatment of UTI with antibiotics. While the place of alkalising agents for symptomatic improvement of dysuria is well-known, the utility of urinary pH manipulation as a method of improving antimicrobial activity and shortening the duration of illness is yet to be identified.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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