

# Efficacy of Mutravirechaniya Dravyas in Recurrent Urinary Tract Infections: A Comprehensive Review

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**Abstract**—Recurrent urinary tract infections (rUTIs) constitute a major public health concern, particularly among women of reproductive age, pregnant individuals, post-menopausal women, diabetic patients, and the elderly. Clinically defined as two or more episodes within six months or three or more episodes within one year, rUTIs are most frequently caused by uropathogenic *Escherichia coli*, which possess virulence determinants such as fimbrial adhesion molecules, intracellular bacterial community formation, and biofilm production. Despite appropriate antibiotic therapy, recurrence rates remain high due to microbial persistence, reinfection, host immune susceptibility, urinary stasis, and disruption of the genitourinary microbiota. The global rise in antimicrobial resistance further complicates management and underscores the need for preventive and integrative therapeutic strategies. In Ayurveda, recurrent urinary infections correlate with Mutrakricchra, Mutraghata, and Mutravaha Srotodushti, primarily involving vitiation of Pitta and Kapha Doshas with secondary Ama accumulation and impaired Agni. Classical management emphasizes Mutravirechaniya Dravyas a group of herbs that promote diuresis, cleanse urinary channels, pacify inflammation, and restore physiological balance. These botanicals are described to exert Pittashamana, Dahanprashamana, Srotoshodhana, and Rasayana actions, thereby addressing both symptomatology and recurrence tendency. Contemporary pharmacological investigations suggest that several Mutravirechaniya herbs exhibit diuretic, antimicrobial, anti-inflammatory, antioxidant, anti-adhesive, and immunomodulatory properties. Experimental models demonstrate nephroprotective activity and inhibition of bacterial colonization, while preliminary clinical studies indicate symptomatic relief and reduced recurrence frequency when used adjunctively. This review synthesizes classical Ayurvedic descriptions with modern biomedical evidence to critically evaluate the potential role of Mutravirechaniya Dravyas in the management and

prevention of recurrent UTIs. Although current evidence is promising, high-quality randomized controlled trials with standardized formulations and microbiological endpoints are required to establish definitive efficacy and clinical guidelines.

**Index Terms**—Recurrent UTI, Mutravirechaniya, Mutrakricchra, Biofilm, Antimicrobial Resistance, Ayurveda, Integrative Urology

## I. INTRODUCTION

Urinary tract infections are among the most common bacterial infections encountered in clinical practice. A substantial proportion of patients experience recurrence despite adequate antimicrobial therapy. Recurrent UTI is typically classified into relapse (infection with the same organism within two weeks of treatment) and reinfection (new infection occurring after initial eradication). Women are disproportionately affected due to shorter urethral length, periurethral colonization, hormonal fluctuations, and sexual activity. Additional risk factors include pregnancy, uncontrolled diabetes mellitus, post-menopausal estrogen deficiency, urinary catheterization, incomplete bladder emptying, nephrolithiasis, and genetic susceptibility affecting innate immunity. 1

The predominant pathogen in community-acquired rUTIs is uropathogenic *Escherichia coli* (UPEC), characterized by adhesins (P fimbriae, type 1 fimbriae), hemolysin production, siderophore-mediated iron acquisition, and capacity to form biofilms. Biofilm formation enables bacterial persistence within bladder epithelial cells and protects pathogens from antibiotic penetration, leading to recurrence. Repeated antibiotic exposure disrupts

normal vaginal and gut microbiota, further increasing susceptibility to reinfection. Globally, antimicrobial resistance among uropathogens particularly extended-spectrum beta-lactamase (ESBL) producing strains poses a growing therapeutic challenge. 2

Conventional management strategies primarily rely on antibiotic therapy, prophylactic low-dose regimens, behavioral modifications, hydration, and, in selected cases, immunoprophylaxis. However, prolonged antibiotic use is associated with adverse effects, microbiome dysbiosis, and resistance development. Consequently, there is increasing interest in complementary approaches that target host factors, urinary dynamics, mucosal immunity, and microbial virulence rather than focusing solely on bactericidal action. 3

Ayurveda provides a distinct conceptual framework for understanding recurrent UTIs. Urinary disorders are described under Mutrakricchra (dysuria syndromes), Mutraghata (obstructive urinary conditions), and Mutravaha Srotodushti (vitiation of urinary channels). Clinical features such as burning micturition (Daha), frequency (Muhurmuhur Mutrapravritti), turbidity (Avila Mutra), and pain correspond closely to modern cystitis presentations. Pathogenesis involves predominance of Pitta Dosh (inflammation, burning sensation) with Kapha contribution (turbidity, mucosal coating, stagnation). Vata may become secondarily aggravated in chronic cases due to tissue depletion and repeated infection. 4 The concept of Srotorodha (channel obstruction) is particularly relevant in recurrent cases, where urinary stasis, crystalluria, or biofilm formation parallels the Ayurvedic description of obstructed Mutravaha Srotas. Ama representing incompletely metabolized toxic byproducts can be correlated with endotoxins, inflammatory mediators, and oxidative stress contributing to mucosal damage. Thus, recurrent UTIs in Ayurvedic pathology are not viewed merely as localized infections but as manifestations of systemic imbalance involving digestive dysfunction, immune vulnerability, and Dosh vitiation. 5

Therapeutically, Ayurveda advocates a multidimensional strategy comprising Dosh pacification, Srotoshodhana (channel cleansing), Agni correction, Rasayana (immune strengthening), and lifestyle regulation. Within this framework, Mutravirechaniya Dravyas occupy a central role. These herbs enhance urinary output, facilitate

elimination of vitiated Doshas through urine, reduce inflammatory heat, and prevent stagnation. Many possess Sheeta Virya, which soothes irritated mucosa and alleviates burning. Others demonstrate Kapha-reducing and anti-obstructive actions, thereby restoring normal urinary flow. 6

From a biomedical perspective, the diuretic effect of Mutravirechaniya herbs may reduce bacterial load by increasing urinary flushing. Anti-inflammatory phytochemicals modulate cytokine pathways, while antioxidant constituents mitigate oxidative tissue injury. Emerging evidence suggests anti-adhesive and anti-biofilm properties that could interfere with bacterial colonization an essential factor in recurrence. Immunomodulatory activity may enhance mucosal defense mechanisms, reducing susceptibility to reinfection. 7

Given the convergence between Ayurvedic pathophysiology and modern understanding of rUTIs particularly regarding inflammation, biofilm formation, and host immune response systematic evaluation of Mutravirechaniya Dravyas is warranted. This review aims to critically analyze classical descriptions, pharmacological data, and available clinical evidence to elucidate their potential role in recurrent UTI management, while identifying gaps requiring further investigation. 8

## II. CONCEPT OF MUTRAVIRECHANIYA IN AYURVEDIC LITERATURE 9

Classical Ayurvedic texts provide detailed descriptions of herbs that promote urinary elimination and alleviate urinary obstruction.

Charaka Samhita classifies Mutravirechaniya Dravyas under Mahakashaya, emphasizing their role in increasing urine output and clearing Dosh accumulation through urinary pathways.

Sushruta Samhita elaborates on Mutrakricchra management, highlighting Pitta-Kapha involvement and recommending Sheeta, Tikta, and Kashaya drugs for symptom relief.

Ashtanga Hridaya integrates both preventive and therapeutic measures, including dietary regulations and lifestyle modifications.

Pharmacodynamically, most Mutravirechaniya herbs exhibit Tikta (bitter), Kashaya (astringent), or Madhura (sweet) rasa; Sheeta virya; and Madhura vipaka. These attributes contribute to Pitta

pacification, anti-inflammatory effects, and soothing of irritated urinary mucosa.

Important Mutravirechaniya Dravyas in Recurrent UTIs

*Tribulus terrestris* (Gokshura)

Gokshura is widely regarded as a prime Mutravirechaniya herb. It possesses Madhura rasa and Sheeta virya, making it particularly suitable in Pittaja Mutrakricchra. Experimental studies demonstrate diuretic activity through enhanced renal blood flow and electrolyte excretion. Anti-inflammatory and mild antimicrobial actions contribute to symptomatic relief. Additionally, its Rasayana property supports mucosal integrity and immune resilience, potentially reducing recurrence frequency. 10

*Boerhavia diffusa* (Punarnava)

Punarnava is recognized for its potent diuretic and anti-edematous effects. Modern pharmacology attributes these actions to alkaloids and flavonoids that enhance renal clearance and exhibit antioxidant properties. Nephroprotective effects are particularly relevant in recurrent infections where inflammation may impair renal function. Punarnava also displays immunomodulatory effects that may enhance host defense mechanisms. 11

*Crataeva nurvala* (Varuna)

Varuna is traditionally indicated in urinary obstruction and bladder dysfunction. Its anti-urolithiatic and bladder- tonic properties help reduce urinary stasis, a recognized risk factor for recurrent infections. By improving bladder emptying and reducing post-void residual volume, Varuna may prevent bacterial colonization. 12

*Bergenia ligulata* (Pashanabheda)

Pashanabheda exhibits lithotriptic, antimicrobial, and anti-inflammatory properties. Phenolic compounds and bergenin are believed to contribute to antibacterial and anti-biofilm activity. These mechanisms may disrupt bacterial adhesion and biofilm formation, addressing a key factor in recurrence. 13

*Aerva lanata* (Gorakshaganja)

Traditionally used in chronic urinary disorders, *Aerva lanata* demonstrates diuretic and antimicrobial properties. It is particularly indicated when recurrent

infections are associated with crystalluria or calculi. 14

Mechanistic Insights 15

The therapeutic efficacy of Mutravirechaniya Dravyas in recurrent UTI can be interpreted through both Ayurvedic and biomedical frameworks.

From an Ayurvedic perspective, these herbs promote Srotoshodhana (channel purification), alleviate Pitta-induced inflammation, and eliminate Kapha-mediated obstruction. They also correct Agnimandya and reduce Ama accumulation, thereby preventing recurrence.

From a biomedical standpoint, proposed mechanisms include:

- Increased urine output facilitating bacterial clearance
- Anti-inflammatory activity reducing mucosal irritation
- Antioxidant action mitigating oxidative stress
- Inhibition of bacterial adhesion and biofilm formation
- Immunomodulatory effects enhancing host defense

This multimodal approach contrasts with single-target antibiotic therapy and may explain reduced recurrence risk when used prophylactically.

Clinical Evidence and Research Trends

Clinical evidence remains emerging. Small-scale trials and observational studies indicate symptomatic improvement, reduced dysuria, decreased frequency, and lower recurrence rates with polyherbal formulations containing Gokshura, Punarnava, and Varuna. Animal studies demonstrate nephroprotective and antimicrobial activity. 16

However, limitations include small sample sizes, lack of standardized extracts, short follow-up periods, and heterogeneity in diagnostic criteria. High-quality randomized controlled trials with microbiological endpoints are needed.

Integrative and Preventive Applications 17

Mutravirechaniya Dravyas may serve as:

- Adjuncts to antibiotic therapy
- Prophylactic agents in recurrent cases
- Supportive therapy in pregnancy under supervision

- Alternative approach in antibiotic-resistant infections
  - Complementary management in diabetic cystitis
- Integration with dietary measures, hydration optimization, and correction of metabolic imbalances enhances therapeutic outcomes.

Safety Considerations

Most Mutravirechaniya herbs are considered safe in classical doses. Nevertheless, careful monitoring is advisable in chronic kidney disease. Pregnant patients require individualized assessment. Long-term prophylactic use should be supervised to ensure appropriate dosing and prevent electrolyte imbalance.

18

Table 1. Ayurvedic Pharmacodynamic Profile of Major Mutravirechaniya Dravyas

Herb	Rasa	Guna	Virya	Vipaka	Dosha Action	Classical Indication
Gokshura	Madhura	Guru, Snigdha	Sheeta	Madhura	Vata-Pitta Shamaka	Mutrakricchra, Ashmari
Punarnava	Tikta, Kashaya	Laghu, Ruksha	Ushna	Madhura	Kapha-Vata Shamaka	Shotha, Mutravaha Dushti
Varuna	Tikta, Kashaya	Laghu	Ushna	Katu	Kapha-Pitta Shamaka	Mutraghata, Ashmari
Pashanabheda	Tikta, Kashaya	Laghu	Sheeta	Katu	Pitta-Kapha Shamaka	Ashmari, Mutrakricchra
Gorakshaganja	Tikta	Laghu	Sheeta	Madhura	Tridosha balancing	Chronic urinary disorders

Table 2. Biomedical Mechanisms Relevant to Recurrent UTIs

Herb	Diuretic Effect	Antimicrobial	Anti-inflammatory	Anti-biofilm	Nephroprotective
Gokshura	Moderate	Mild	Yes	Possible	Yes
Punarnava	Strong	Moderate	Strong	Emerging evidence	Strong
Varuna	Moderate	Mild	Moderate	Limited data	Moderate
Pashanabheda	Mild-Moderate	Moderate	Yes	Yes	Mild
Gorakshaganja	Moderate	Mild	Yes	Limited data	Moderate

Table 3. Correlation Between Ayurvedic Concepts and Modern Pathophysiology

Ayurvedic Concept	Description	Biomedical Equivalent
Mutravaha Srotodushti	Obstruction/inflammation of urinary channels	Cystitis, urethritis
Pitta Dushti	Burning, inflammation	Inflammatory cytokine activity
Kapha Dushti	Turbidity, stagnation	Biofilm, mucus accumulation
Ama	Metabolic toxins	Endotoxins, oxidative stress
Srotoshodhana	Channel purification	Improved urinary flow & drainage

Table 4. Clinical Applications in Recurrent UTI Scenarios

Clinical Scenario	Suggested Herb/Combination	Rationale
Recurrent E. coli infection	Gokshura + Punarnava	Diuretic flushing + anti-inflammatory
Post-void residual urine	Varuna-based formulation	Improves bladder tone
UTI with calculi	Pashanabheda + Gokshura	Lithotriptic + antimicrobial
Diabetic recurrent UTI	Punarnava + Rasayana support	Nephroprotection + immunity
Pregnancy (supervised)	Mild Gokshura preparation	Sheeta, soothing, safer profile

III. DISCUSSION

Recurrent urinary tract infections represent a multifactorial clinical entity involving complex interactions between microbial virulence, host immunity, urinary tract dynamics, metabolic status, and environmental influences. The persistent nature of

rUTIs cannot be adequately explained solely by bacterial presence; rather, it reflects a dynamic imbalance between host defense mechanisms and pathogen survival strategies. In this context, Mutravirechaniya Dravyas offer a systems-oriented therapeutic model that aligns closely with current biomedical understanding of recurrence. 19

From a microbiological perspective, the central challenge in rUTIs lies in bacterial adhesion and biofilm formation. Uropathogenic *Escherichia coli* (UPEC) attach to urothelial cells via fimbrial adhesins, invade epithelial layers, and form intracellular bacterial communities. These biofilms confer resistance to antibiotics and immune clearance. Conventional antimicrobial therapy effectively reduces planktonic bacterial populations but often fails to eradicate intracellular reservoirs, leading to relapse. Certain Mutravirechaniya herbs, particularly those rich in phenolics and flavonoids, demonstrate anti-adhesive and anti-biofilm properties in experimental models. Such activity may disrupt the early stages of colonization, thereby reducing recurrence risk. 20

The diuretic action of Mutravirechaniya Dravyas represents a clinically relevant mechanism. Enhanced urine flow increases mechanical flushing of bacteria, reduces urinary stagnation, and limits contact time between pathogens and urothelium. This correlates with the Ayurvedic concept of Srotoshodhana cleansing of Mutravaha Srotas. Urinary stasis, whether due to incomplete bladder emptying, calculi, pregnancy-related compression, or metabolic dysfunction, is a recognized risk factor for recurrence. Herbs such as Gokshura and Punarnava may improve renal perfusion and urinary output, thereby restoring physiological drainage. 21

Inflammation plays a pivotal role in symptom generation and mucosal vulnerability. Recurrent infections induce a sustained inflammatory response characterized by cytokine release, oxidative stress, and epithelial damage. This inflammatory microenvironment may facilitate bacterial persistence. Many Mutravirechaniya herbs exhibit significant anti-inflammatory and antioxidant effects through modulation of cyclooxygenase pathways, nitric oxide production, and reactive oxygen species scavenging. From an Ayurvedic standpoint, this corresponds to Pitta pacification and Daha-prashamana. By attenuating inflammation, these herbs may promote mucosal healing and restore epithelial integrity, reducing susceptibility to reinfection. 22

Immunological factors are increasingly recognized in rUTI pathogenesis. Deficiencies in innate immune responses, altered Toll-like receptor signaling, and impaired mucosal immunity contribute to recurrent episodes. The Rasayana properties attributed to several Mutravirechaniya herbs suggest

immunomodulatory potential. Experimental evidence indicates enhancement of macrophage function, modulation of cytokine profiles, and improvement in antioxidant defense systems. Such actions may strengthen host resistance rather than merely suppress microbial load. This holistic immunological support distinguishes Ayurvedic management from antibiotic-centric approaches. 23

Another critical consideration is antimicrobial resistance. Prolonged or repeated antibiotic exposure disrupts the vaginal and gut microbiota, leading to dysbiosis and colonization by resistant strains. Mutravirechaniya Dravyas, when used as adjunctive or prophylactic therapy, may reduce reliance on continuous antibiotic regimens. Their multimodal mechanisms—diuretic, anti-inflammatory, anti-adhesive, and immunomodulatory target both host and pathogen without exerting strong selective pressure for resistance. While herbal antimicrobial potency may be milder compared to antibiotics, their preventive application could decrease recurrence frequency and antibiotic dependency. 24

Metabolic and systemic factors also influence recurrence. Diabetes mellitus, obesity, and poor glycemic control create a favorable environment for bacterial proliferation due to glycosuria and immune impairment. Ayurveda interprets this as Kapha dominance with impaired Agni. Punarnava and other Mutravirechaniya herbs possess metabolic regulatory and anti-inflammatory effects that may indirectly improve urinary health in such patients. Additionally, nephroprotective properties are particularly relevant in individuals experiencing repeated inflammatory insult to renal tissue. 25

Despite promising pharmacological data, the clinical evidence base remains limited. Many available studies are small-scale, non-randomized, or lack microbiological endpoints. Standardization of herbal extracts, dosage forms, treatment duration, and outcome measures is essential for generating reproducible data. Furthermore, future trials should distinguish between relapse and reinfection, include urine culture confirmation, and assess recurrence rates over extended follow-up periods. 26

Integration with modern urological practice requires careful consideration of safety, herb–drug interactions, and patient-specific factors such as pregnancy and chronic kidney disease. Although classical texts describe these herbs as safe in appropriate doses,

contemporary pharmacovigilance and toxicity profiling are necessary for broader clinical acceptance. Establishing standardized phytochemical markers and quality control parameters will further enhance reliability. 27

An interdisciplinary approach combining Ayurvedic pharmacology, microbiology, immunology, and clinical urology could yield novel preventive protocols. For example, combining Mutravirechaniya Dravyas with behavioral modifications (hydration optimization, post-coital voiding), glycemic control, and targeted short-course antibiotics during acute episodes may provide balanced, evidence-informed care. 28

In summary, the discussion reveals that Mutravirechaniya Dravyas align mechanistically with modern concepts of recurrent UTI pathogenesis. Their potential lies not merely in antimicrobial activity but in restoring urinary tract homeostasis, improving host resilience, and preventing recurrence through a multidimensional approach. 29

#### IV. CONCLUSION

Recurrent urinary tract infections represent a persistent and increasingly complex therapeutic challenge, exacerbated by antimicrobial resistance and biofilm-mediated persistence. Conventional antibiotic strategies, while essential in acute management, are often insufficient to prevent recurrence and may contribute to microbiome disruption and resistance development. Mutravirechaniya Dravyas offer a comprehensive Ayurvedic strategy that addresses key pathogenic mechanisms of rUTIs, including urinary stasis, mucosal inflammation, oxidative stress, microbial adhesion, and impaired immunity. Their diuretic action facilitates bacterial clearance; anti-inflammatory and antioxidant properties promote epithelial recovery; and immunomodulatory effects enhance host defense. This integrative mechanism positions them as promising adjunctive or prophylactic agents in recurrent UTI management. However, the current evidence base is predominantly preclinical or observational. Rigorous randomized controlled trials with standardized formulations, defined microbiological endpoints, and long-term follow-up are necessary to validate efficacy. Integration of traditional knowledge with contemporary scientific methodology will be crucial

in establishing clinical guidelines and optimizing patient outcomes. In conclusion, Mutravirechaniya Dravyas hold substantial therapeutic potential in recurrent urinary tract infections by offering a systems-based, preventive, and resistance-conscious approach. With further scientific validation, they may significantly contribute to integrative urological practice and reduce the global burden of recurrent UTIs.

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