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Urological Effects of Ketamine Abuse

John Shung-Lai Leung and Wai-Kit Ma

Abstract

Emerging evidence has shown that long-term and chronic ketamine use or abuse can lead to damages in the urinary tract, a spectrum of clinical presentations from mild irritative lower tract symptoms to painful gross haematuria and renal damages. First reported by a Hong Kong group of urologists in 2007, the phenomenon has since then been identified worldwide. Most of the ketamine abusers were adolescents and young adults, and the symptomatology resembled those of chemical cystitis or interstitial cystitis. Endoscopic features of ulcerative cystitis, radiological features of thickened and contracted bladder wall with or without obstruction to upper urinary tract, and histopathological features of inflammation and fibrosis and urothelial metaplasia changes were described. With increasing clinical experience in managing this group of patients, clinical pathways and medical and surgical treatment options have been developed. Animal studies on the effects of ketamine exposure on the urinary system have also been conducted to help us understand the underlying pathophysiology for this distinct entity.

Keywords: ketamine, cystitis, hydronephrosis, detrusor overactivity, uropathy

1. Introduction

Ketamine is listed in the WHO Essential Medicines List since 1985 as an anaesthetic and analgesic. Unlike other commonly used anaesthetic agents, ketamine does not tend to cause respiratory depression or hypotension, making it ideal for use as a general sedative and in veterinary medicine [1].

However, ketamine is also a drug of abuse. The United Nation's World Drug Report 2019 shows that ketamine has been the dominant hallucinogenic seized by authorities globally, accounting for 87% of such seizures in the past 5 years [2]. In 2017, the global quantity of ketamine seized was approximately 11,000 kilogrammes, the majority of which was in Asia [3]. Most ketamine seized, in the order of descending quantity, was reported by mainland China, followed by Taiwan, Hong Kong, Malaysia, Myanmar, Thailand, the United Kingdom, India, and the Netherlands [3]. In Taiwan, ketamine has been the most frequently abused illicit drug since 2006. The volume of seizures there grew from 916 kg in 2009 to 1187 in 2010 [4]. However, ketamine is becoming more and more popular not only in Southeast Asia but in Europe as well. The number of ketamine users in the United Kingdom grew from 85,000 in 2006 to 113,000 in 2008, becoming the fourth most popular illicit drug among UK clubbers [5]. Its popularity could be explained by its low market price among recreational drugs and also the difficulty in cracking down on its trafficking, as it is produced legally for medical use [6].

The chronic and illicit use of ketamine is associated with urinary tract damages. Structural damage to the bladder, ureters, and kidneys has been demonstrated in numerous animal and human studies. Patients usually present to the urological service with symptoms such as urinary frequency, haematuria, and dysuria. Management is multidisciplinary, as a big part of treatment success lies not only in urological interventions but also in successful abstinence.

2. Epidemiology of ketamine-associated cystitis

The exact prevalence of ketamine-associated cystitis is difficult to ascertain, as most users are reluctant to seek medical attention despite symptoms. A study in Taiwan conducted in 2019 by Li et al. reported that whilst 84% of chronic ketamine abusers demonstrated urinary tract symptoms, only 48% sought treatment [7]. A survey involving 3806 participants in the United Kingdom by Winstock et al. found that 26.6% of ketamine users report urinary symptoms and that the symptoms are significantly related to both frequency and duration of use [8]. Similarly, Pal et al. from the United States conducted a survey involving 18,802 participants which reported a 30% prevalence of lower urinary tract symptoms (LUTS) among recent ketamine users [9].

Lower urinary tract symptoms, as well as dysuria and haematuria, are the most common symptoms caused by chronic ketamine abuse. LUTS in the setting of ketamine cystitis usually comprises urinary frequency, feeling of incomplete bladder emptying, and nocturia. More than 50% of users complain of urinary frequency after using ketamine for about 2 years [7]. The severity and number of symptoms are correlated with not only the duration of use but also the route of administration. Ketamine may be cut up into a powder form before being inhaled or smoked with pipe-like devices. Snorting causes significantly more symptoms than smoking. This is possibly due to a higher amount of ketamine entering the circulation via the nasal mucosa [7].

The combined use of ketamine with other substances such as marijuana and 3,4-methylenedioxy-methamphetamine (MDMA) has also been found to significantly increase the severity of LUTS. Marijuana enhances the expression of cannabinoid receptors CB1 and CB2, which are found in the human bladder urothelium [10]. This is implicated in the worsening of storage symptoms such as frequency and urgency. The mechanism through which MDMA exacerbates LUTS remains to be elucidated.

3. Pathogenesis of ketamine cystitis

A number of mechanisms have been proposed to explain the pathogenic effects of ketamine on the urinary system. These include (1) direct toxicity of ketamine or its metabolites on the bladder tissues; (2) microvascular changes in the bladder and kidneys by ketamine or its metabolites; and (3) delayed (type IV) hypersensitivity against the urothelium due to ketamine or its metabolites [11]. Infection is unlikely to play a role in the primary pathogenesis of ketamine cystitis, as the vast majority of patients do not have a positive urine bacterial culture. As of yet, there has not been a single conclusive theory on the mechanism of ketamine-induced cystitis.

In vitro studies on human urothelial cells have demonstrated dose-dependent toxicity of ketamine to human urothelial cells. The damage is carried out by both ketamine itself and its primary metabolite (norketamine) [12]. Norketamine is generated as ketamine undergoes hepatic metabolism. Both ketamine and norketamine are subsequently excreted in the urine. Ketamine and norketamine are equally toxic to the urothelium in in vitro studies, but norketamine remains in the urine for longer than ketamine, and hence norketamine may be accountable for more of the damage

done [13]. As with other toxic exposures, daily exposure has been found to be more damaging than a one-off exposure. The accepted anaesthetic dosage of ketamine for human medical use is 0.5–2 mg/kg, but much higher concentrations are abused in recreational use (up to 20 g per day in some users) [13]. As aforementioned in the previous section, it also takes approximately 2 years of abuse before cystitis symptoms arise. Therefore, as ketamine is used at much lower doses as well as frequency in the context of anaesthesia as compared to daily abuse, the medical use of ketamine for one-off anaesthesia is less likely to cause significant ketamine cystitis.

The hypothesis that ketamine and norketamine exert a direct effect on the urothelium is based on the knowledge that both chemicals are excreted by the urine and have a long contact time with the urothelium (ketamine 5 days, norketamine 6 days) after ingestion [14].

The urinary tract from the renal pelvis to the proximal urethra is covered by the urothelium, a highly specialised transitional epithelium capable of stretching to accommodate various degrees of distension in response to urine volume. The urothelium comprises three layers—superficial, intermediate, and basal. Under the urothelium lies the submucosa, then the detrusor muscle, and then the adventitia.

Classic histological changes found in ketamine cystitis include denudation of the urothelium, as well as inflammatory changes including oedematous vessels, and infiltration by eosinophils and T-lymphocytes [15]. The affected urothelium loses its superficial layer (which provides a barrier function), thus exposing the stroma to further insults from urinary ketamine and norketamine. This may be one of the mechanisms by which ketamine causes cystitis and the resultant symptoms. Some of these histological changes are similarly seen in interstitial cystitis (chronic bladder pain in the absence of an identifiable aetiology) [16]. Additionally, haematoxylin and eosin staining in the urothelium affected by ketamine cystitis may in some cases display apparent dysplastic changes with the loss of epithelial cohesion. Such changes mimic the histology of carcinoma in situ, and hence the clinical history of ketamine abuse should alert the clinician or pathologist to the possibility of misdiagnosis of carcinoma in situ [12].

The infiltration by T-lymphocytes suggests that a delayed (type IV) hypersensitivity reaction to ketamine may also play a role in the pathogenesis of ketamine cystitis [17]. This is because T-lymphocytes are heavily implicated in type IV hypersensitivity reaction, and it is known that type IV hypersensitivity reactions occur only after prolonged exposure to the causative agent. This reaction conforms to the temporal profile of the development of ketamine cystitis, where symptoms usually develop only after 2 years of abuse.

4. Clinical presentation

The irritative effects of ketamine on the urinary system, especially the bladder, produce myriad symptoms. These include:

- Urinary frequency
- Feeling of incomplete bladder emptying
- Nocturia
- Urinary urgency
- Urge incontinence

- Haematuria
- Suprapubic pain or 'bladder pain'

The typical complaint from the affected patients is 'painful, small voids', closely mimicking that of interstitial cystitis. These symptoms typically develop after 2 years of ketamine abuse. A study in Hong Kong by Ng et al. has demonstrated the relative prevalence of symptoms as follows: urgency (92%), frequency (84%), nocturia (88%), dysuria (86%), and haematuria (68%) [18]. The most bothersome symptoms reported by users are typically urinary frequency, nocturia, and urgency. This is because of the need of frequency visits to the bathroom, which interferes significantly with their daily activities [7].

The clinician may evaluate symptoms using standardised methods such as frequency-voiding charts (also known as a 'bladder diary') and questionnaires such as the Pelvic Pain and Urgency/Frequency (PUF). A frequency-voiding chart involves the patient recording the volume of every fluid intake and void and also instances and degrees of urge incontinence, if any. Reviewing a frequency-voiding chart allows the patient to communicate effectively with the clinician the frequency and nocturia experienced. Ketamine cystitis typically produces a low-compliance bladder, manifesting as frequency, low-volume voids. Urge incontinence is the sudden and compelling desire to pass urine that is difficult to defer and is accompanied by involuntary leakage.

The Pelvic Pain and Urgency/Frequency questionnaire is a symptom score questionnaire developed and validated for the diagnosis of interstitial cystitis [19]. As mentioned, interstitial cystitis produces symptoms and histological changes in the bladder akin to those found in ketamine cystitis, and studies have validated the use of this questionnaire to score patients experiencing symptoms of ketamine cystitis [18]. The questionnaire includes eight questions evaluating daytime frequency, nocturia, pelvic pain, urinary urgency, the degree to which these symptoms bother the patient, and sexual function. PUF generates a symptom score and bother score, which total at 35. In a patient with history of significant ketamine abuse, a score of ≥ 15 indicates the presence of significant cystitis symptoms, thus leading to the diagnosis of ketamine cystitis. The PUF is a useful tool not only for the diagnosis of ketamine cystitis but also for symptom quantification so that its severity and response to treatment could be monitored over time.

5. Clinical investigation findings

Cystoscopy, computed tomography (CT), ultrasonography, and pyelography are examples of investigations that may demonstrate the structural damage implicated in ketamine cystitis [20]. Cystoscopy reveals inflammatory changes such as telangiectasia (indicative of neovascularisation), ulceration, or even petechial haemorrhage in severe cases. Biopsies of the affected bladder urothelium will reveal histological changes mentioned earlier in the chapter, including denuded epithelium and infiltration by eosinophils and lymphocytes. Computed tomography may show bladder wall thickening and peri-vesical stranding, both of which are indicative of chronic inflammation of the bladder wall (**Figure 1**). Upper tract damage usually manifests itself as unilateral or bilateral hydronephrosis, with ureteric wall thickening, or luminal narrowing and strictures. CT, pyelography, and ultrasound are all suitable modalities to demonstrate hydronephrosis (**Figures 2–4**). CT and pyelography have the additional benefit of evaluating the exact level of ureteric stricturing.

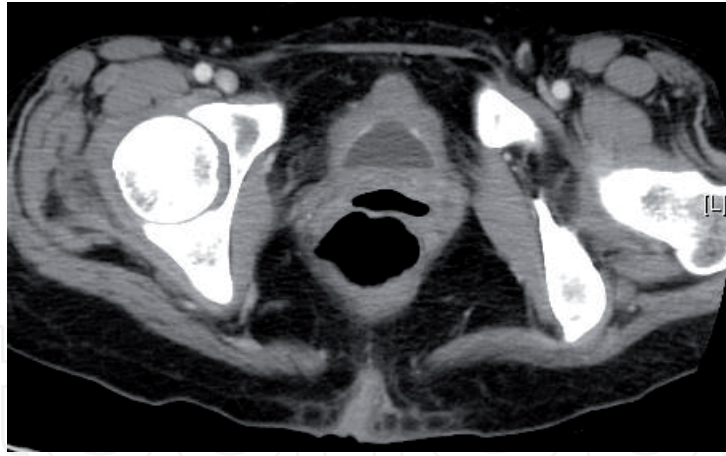


Figure 1.
Contrast CT scan image showing a thickened and contracted bladder in a patient with a 7-year history of ketamine abuse.



Figure 2.
Reconstructed contrast CT urogram showing bilateral hydronephrosis and hydroureter down to the level of the vesicoureteric junctions. The bladder also appears small with generalised wall thickening. This patient has an 8-year history of ketamine abuse.



Figure 3.

This is an antegrade pyelogram of a patient suffering from ketamine cystitis. Contrast is injected through the percutaneous nephrostomy. There is hydronephrosis and a contrast upholding at the level of the L3 vertebra. This is suggestive of a ureteric stricture at that level causing hydronephrosis.



Figure 4.

Ultrasound image of the left kidney of a patient with ketamine cystitis complicated by acute left pyelonephritis. This patient had a background of ketamine cystitis with bilateral hydronephrosis. She presented acutely with left loin pain and fever. The ultrasound image shows debris in the chronically dilated renal pelvis. This is compatible with acute pyelonephritis complicating ketamine cystitis. A combination of chronic obstruction and vesicoureteral reflux has likely contributed to the development of upper tract infection.

Apart from assessing the degree of structural damage, the functional capacity of the urinary system should also be assessed. Urodynamic studies, such as video cystometrogram, reveal reduced bladder capacities, reduced bladder compliance, and sometimes detrusor overactivity even at low bladder volumes. Bladder capacities of

ketamine cystitis patients are typically <150 ml, and detrusor overactivity has been shown to be evident at bladder volumes as low as 14 ml [21]. This means that such patients will not only complain of very frequent but small voids, they are also likely to experience urge incontinence. One can see how disabling such symptoms are from these investigation findings (Figures 5–7).

Renal impairment can be reflected from raised serum creatinine or impaired creatinine clearance and estimated glomerular filtration rate. Renal impairment may stem from vesicoureteral reflux (VUR) due to chronic reduction in bladder

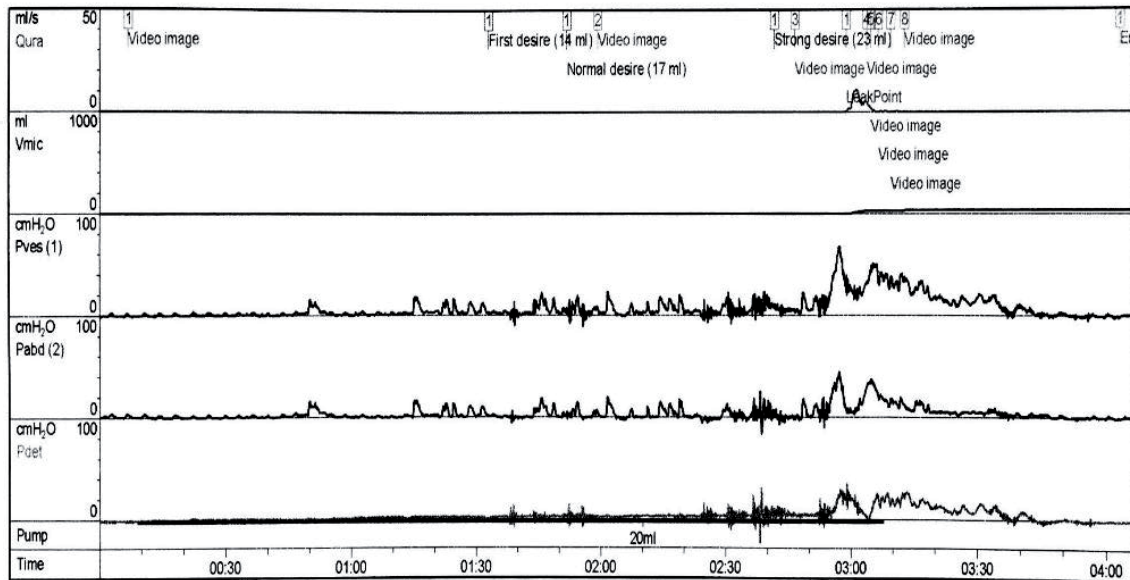


Figure 5. Cystometrograph (filling phase) of a patient with a 10-year history of ketamine abuse. First desire to void was recorded at 14 ml of bladder filling. Also note the multiple spikes at the lowermost tracing indicative of detrusor overactivity. (Pves, intravesical pressure; Pabd, intra-abdominal pressure; Pdet, subtracted detrusor pressure of Pves–Pabd).

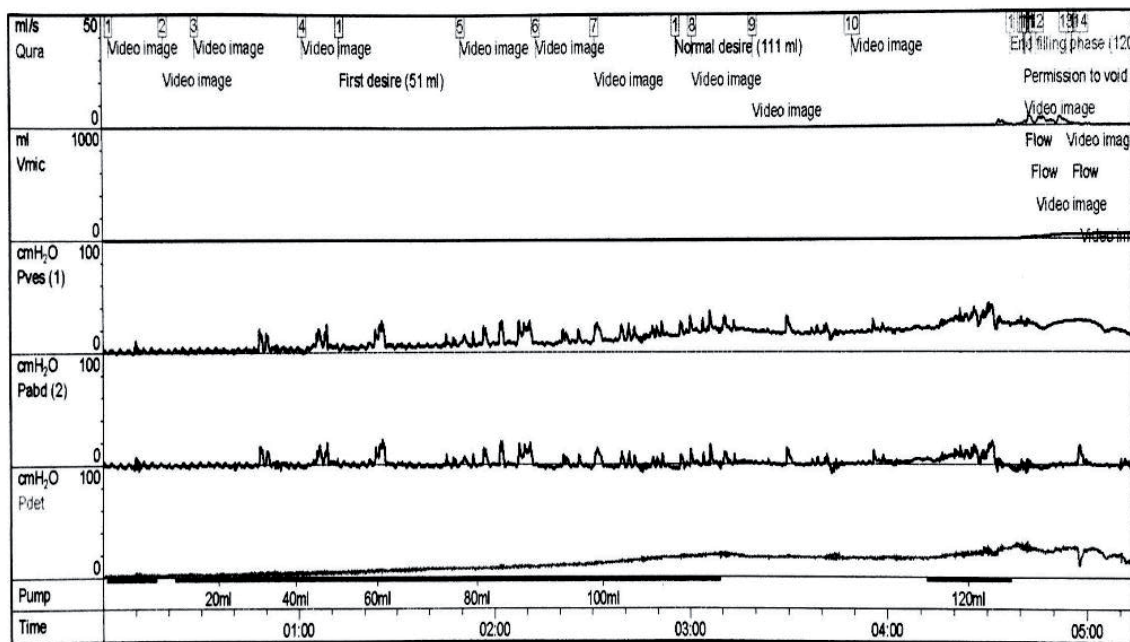


Figure 6. Cystometrograph (filling phase) of the same patient after 3 years of abstinence. First desire to void at 51 ml. Note the difference in the scale of the x-axis denoting volume. The detrusor overactivity has also dampened, as shown by the smoother Pdet tracing.

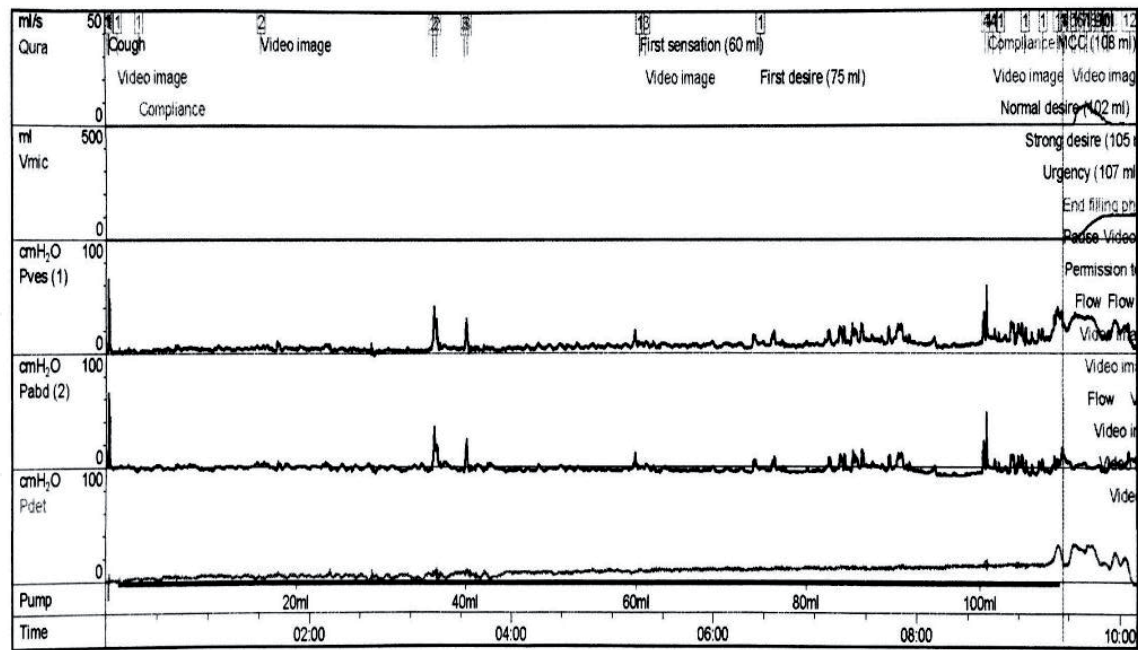


Figure 7. Cystometrogram (filling phase) of the same patient after 8 years of abstinence. First desire to void at 75 ml. Much improved bladder compliance as shown by the relatively smooth Pdet tracing.

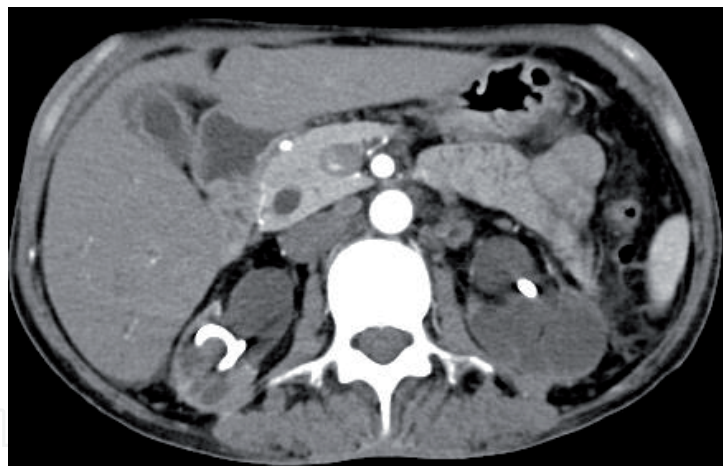


Figure 8. Contrast CT scan image of a patient with more than 3 years of ketamine abuse, showing bilateral atrophic kidneys and hydronephrosis. This patient required bilateral percutaneous nephrostomies (also seen on this image) for upper tract urinary diversion.

compliance. VUR can be demonstrated on video cystometrogram as a reflux of contrast material from the bladder up to the ureters. VUR predisposes the upper tract from urinary tract infections, increasing the risk of recurrent pyelonephritis and resultant renal scarring (**Figure 2**). Hydronephrosis as a result of ureteric narrowing is also a cause of renal impairment in these patients. Ureteric narrowing is likely secondary to urinary ketamine and its metabolites causing transmural inflammation and swelling or even fibrosis and strictures (**Figure 8**).

Papillary necrosis may be seen on renal ultrasound or on contrast studies such as an intravenous urogram or computed tomography [11]. The contrast material fills necrotic cavities located in the renal papillae. Sometimes, sloughed necrotic material may pass into the ureter, causing obstruction, and appear as a filling defect.

6. Management

6.1 Abstinence and a multidisciplinary approach

The management of ketamine cystitis aims at abating the debilitating urinary symptoms and preventing further damage to the urinary tract. The most important components of the management plan therefore lie in early diagnosis and early abstinence, as this aims to effectively remove ketamine and its metabolites from the urinary system before irreparable damage to the urinary system sets in. A large-scale study involving more than 1000 ketamine users reported that up to 50% of users report symptomatic improvement after cessation of use. Urinary frequency has been shown to be the first symptom to improve [8]. That said, as with any detoxification program, psychosocial challenges pose a big barrier to long-term abstinence. It is therefore imperative that the clinician solicits help from relevant parties such as social workers, clinical psychologists, or even psychiatrists to form a multidisciplinary approach in managing these patients [22]. This process involves first identifying those suffering from ketamine cystitis, then explaining the relationship between ketamine use and cystitis, and finally embarking on the detoxification journey. As mentioned earlier in the chapter, the PUF scale serves as a standardised and validated means of identifying ketamine users suffering from cystitis. Success in multidisciplinary management has been demonstrated by outreach teams comprising urologists, psychiatrists, social workers, and nurses in Hong Kong [23].

6.2 Oral agents

Although the precise mechanism of injury in ketamine cystitis has yet to be elucidated, it is clear that it involves inflammation of the urothelium akin to that of interstitial cystitis. Medications that aim to reduce inflammation, such as nonsteroidal anti-inflammatory drugs (NSAIDs) and glucocorticoids, have thus been studied in the treatment of ketamine cystitis symptoms. Other treatment regimens involving the use of antibiotics, anti-muscarinic agents, and beta-3 agonists have also been examined. However, the results from the medication therapy have been suboptimal overall [24].

Medication therapy may not result in significant improvements in LUTS for these patients, but analgesics should still be employed generously. This is because ketamine itself possesses analgesic properties, and therefore abstinence after long periods of abuse may produce pain akin to a withdrawal effect. Analgesics such as paracetamol, phenazopyridine, or even narcotic analgesics such as tramadol may be used on top of NSAIDs in high doses as pain relief during the initial period of detoxification [25].

6.3 Intravesical therapies

Ketamine and its metabolites cause denudation of the urothelium, exposing the underlying submucosa and stroma of the bladder wall to further toxic damage. This produces the typical LUTS as well as the structural changes such as wall thickening and reduction in compliance. This has prompted investigations into the effectiveness of intravesical therapies that aim to restore the integrity of the urothelium so that the underlying tissue may no longer be exposed to the toxicities of ketamine and its metabolites. Intravesical instillation of a glycosaminoglycan, such as hyaluronic acid or chondroitin sulphate, has been proposed to reconstitute the barrier

function provided by the urothelium and enhance healing. Reports of significant reductions in symptoms in patients treated with weekly intravesical instillations of hyaluronic acid or chondroitin sulphate have been published recently [26]. These patients not only reported a reduction of LUTS, but follow-up cystoscopy with biopsies showed decreased inflammatory cell infiltration, less inflammatory hypervascularity, as well as regeneration of the urothelium [27].

Cystoscopic injection of botulinum toxin into the bladder wall, followed by hydrodistension, is another intravesical treatment that has been shown to relieve symptoms of ketamine cystitis [28]. Botulinum toxin type A inhibits the presynaptic release of neurotransmitters such as acetylcholine, thus inactivating neuromuscular junctions and reducing detrusor activity. The patient is typically put under spinal anaesthesia, and a cystoscope is then advanced into the bladder. 20 ml of botulinum toxin type A at a concentration of 200 IU in 20 ml is then injected into 40 points in the bladder wall. There is currently no standard protocol for the technique of hydrodistension, but authors have performed it by filling the bladder with saline under a pressure of 80 cmH₂O, at a volume of 150–200 ml, for a duration of 5 minutes [29].

6.4 Surgical therapies

The bladder in a patient with severe ketamine cystitis is thickened and fibrotic and has poor compliance. Apart from severe LUTS, these changes may also cause vesicoureteral reflux and upper tract damage. Such patients are at risk of chronic renal failure. Surgical treatment in the form of augmentation cystoplasty is therefore an option to increase the capacity and compliance of the bladder, so that symptomatic improvement and upper tract protection could be brought about through a single procedure. Techniques vary, but an option is to use a 25 cm segment of the ileum and sew it to a surgically created clam-like opening of the bladder in order to augment its volume and compliance [30]. Contraindications to augmentation cystoplasty using bowel include any condition that renders the bowel abnormal at the baseline, for example, inflammatory bowel disease (Crohn's disease, ulcerative colitis) and previous gut resection (such that further resection may predispose the patient to malabsorption or even short gut syndrome). Another alternative is to use a portion of the stomach, termed gastrocystoplasty. This has its own issues, as the hydrochloric acid produced by the stomach mucosa may cause haematuria-dysuria syndrome, peptic ulceration in the bladder, and alkalosis. Complications include a mortality rate of up to 2.7%, small bowel obstruction, fistulation, and renal failure (due to the reabsorption of urinary waste through the bowel segment). Some patients may furthermore require clean intermittent catheterisation to more effectively empty the bladder. Patient selection is paramount when considering augmentation cystoplasty for ketamine cystitis patients. Failure of abstinence after surgery results in rapid reabsorption of ketamine from the urine through the bowel segment. Ketamine and its metabolites are hence recirculated, excreted in the urine again, and once again exerting their toxic effects on the urothelium. Augmentation cystoplasty with bowel may therefore even accelerate upper tract damage should the patient fail to abstain from ketamine postoperatively. The patient should also be willing to comply with clean intermittent self-catheterisation should it be required [30].

An alternative surgical strategy is an ileal conduit [31]. This involves bringing both the ureters to an opening in the abdominal wall through a surgically created segment of the ileum. This obviates the need for clean intermittent catheterisation and offers quicker postoperative recovery. However, as this is an incontinent type of urinary diversion, the patient would have to live with a lifelong urostomy bag.

6.5 Upper tract protection

Some patients present with bilateral hydronephrosis with or without impairment of renal function. This could be due to vesicoureteral reflux or ureteric strictures. As most patients with ketamine cystitis are young, it is of paramount importance that their upper tract is protected to prevent chronic renal disease. Methods to achieve this include percutaneous nephrostomy and ureteral stenting. Percutaneous nephrostomy involves placing a plastic tube through the skin into the renal pelvis so that the urine produced by the kidney may drain through the tube into an external bag instead of being trapped in the obstructed system. The drainage of the urine through nephrostomy tubes into an external bag also reduces the LUTS from ketamine cystitis, as there is significantly less urine entering the bladder. Disadvantages include inconvenience, as well as nephrostomy tube-related

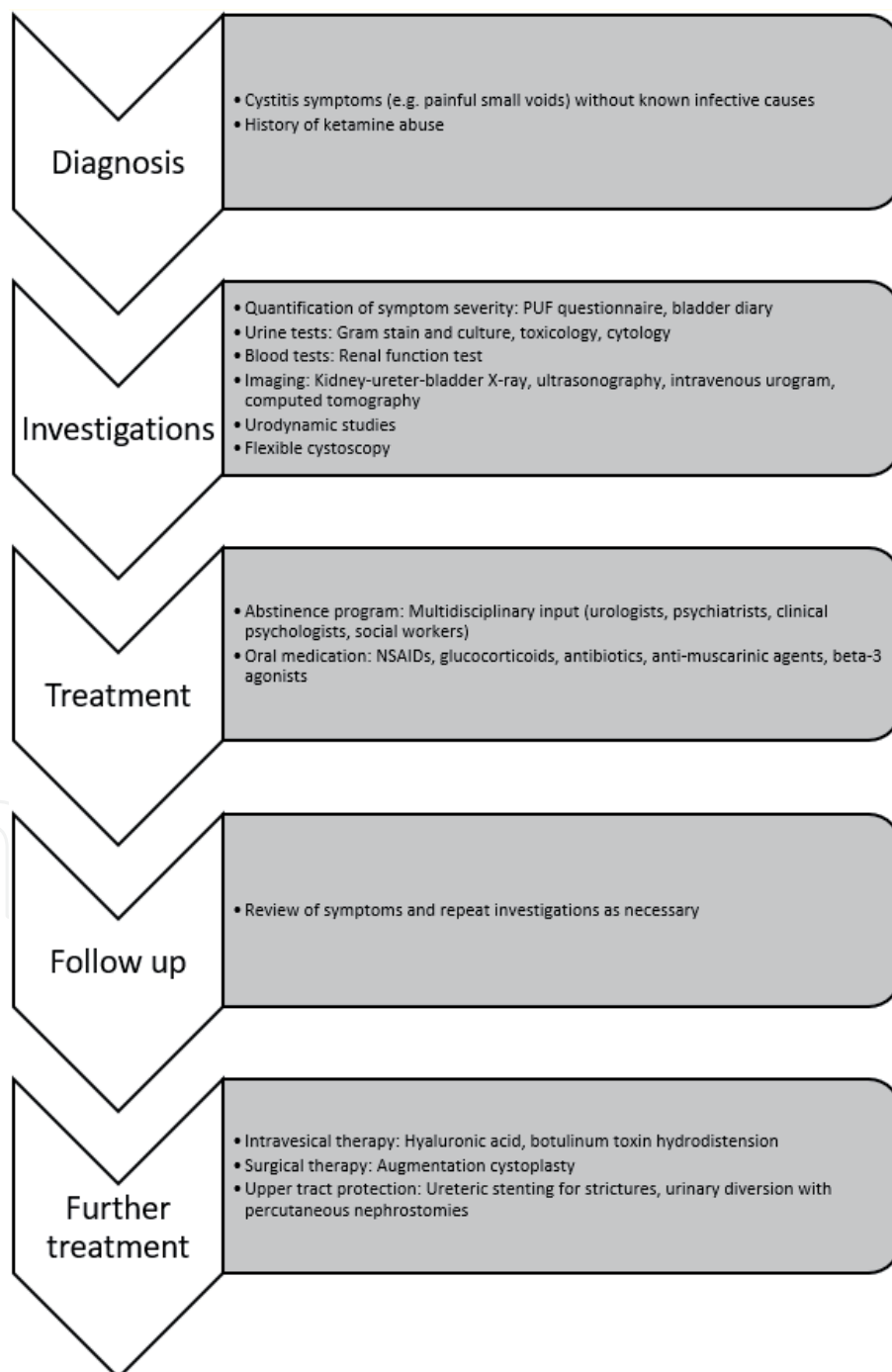


Figure 9. Clinical pathway for the management of ketamine cystitis (adapted from Ma et al.) [22].

complications such as frequent dislodgement, and blockage. The inconvenience associated with the use of a nephrostomy tube is due not only to the presence of the tube exiting the loin but also to the bag to which it is connected. Another way of ensuring upper tract drainage is by retrograde stenting [32]. Double J stents can be inserted via a cystoscope to ensure ureteric patency. This method obviates the need for external tubes and bags, but as urine is allowed to flow into the bladder, LUTS may persist. Additionally, some patients may also suffer from stent symptoms, which include LUTS due to the stent tips in the bladder irritating the urothelium.

6.6 Clinical pathway

Urologists in Hong Kong such as Ma et al. have established a clinical pathway in order to guide and standardise the management of ketamine cystitis [22]. Patients going through such a clinical pathway will receive a full workup of the extent of their ketamine cystitis and complications and receive treatment accordingly (**Figure 9**).

7. Challenges

The treatment of ketamine cystitis revolves heavily around abstinence. However, addiction and withdrawal symptoms, as well as the socioeconomic factors that contribute to the persistence of ketamine abuse, are not the only factors that hamper successful abstinence.

Abstinence from ketamine in the presence of ketamine cystitis is made more difficult by bladder pain and dysuria. As ketamine exhibits analgesic effects, it paradoxically suppresses the bladder pain and dysuria caused by ketamine cystitis. Subsequently, the cessation of ketamine use will unmask more intense cystitis symptoms. If such symptoms are inadequately controlled by more effective analgesics, the patient may be driven to use ketamine as a means to control the cystitis symptoms. Such a pattern of abstinence, failure of symptomatic control, and relapse creates a vicious cycle. It is therefore important to prescribe the patient with adequate analgesia according to the analgesic ladder to effectively suppress bladder pain and dysuria. The flip side of this is that the patient may in turn become dependent on the prescribed analgesics, especially if opioids are used [25].

Failure of abstinence in patients who have received surgical treatment such as augmentation cystoplasty may prove to be detrimental. As mentioned in the Management section, the reabsorption of ketamine and its urinary metabolites via the bowel segment used for augmentation cystoplasty may accelerate damage to the upper urinary tract, making the surgical treatment counterproductive. Correct patient selection for surgical treatment weighs heavily upon the urologist [31].

Upper tract protection by means of bilateral percutaneous nephrostomies (PCNs) may be the last resort for patients with identifiable hydronephrosis and impaired renal function [33]. However, as most ketamine cystitis patients are young and ambulatory, bilateral PCNs prove to be a cumbersome and a general nuisance. Not only are the nephrostomy tubes and bags inconvenient to live with, they also come with issues such as dislodgement or tube blockage. Tube-related issues may require hospitalisation for the revision of the nephrostomies, which adds not only to patient dissatisfaction but also to overall healthcare costs. With such inconvenience, the patient may be deterred from complying with having bilateral PCNs and in turn exposes himself to risks of chronic kidney disease and eventual dialysis dependence. Dialysis dependence in this age group makes the employment difficult, which then contributes to a lack of socioeconomic support and again makes abstinence a challenge.

8. Conclusions

Long-term ketamine abuse leads to the development of ketamine cystitis. Symptoms are debilitating and interfere significantly with the patient's daily activities. Furthermore, the upper tract may also suffer from irreversible damage, such as ureteric stricturing and finally chronic renal failure. Management of ketamine cystitis starts with its identification. This could be achieved using standardised symptom score questionnaires in known abusers of ketamine. Investigations such as blood tests, computed tomography, and cystometrograms are useful to characterise and delineate the extent of ketamine cystitis and its sequelae. The cornerstone of effective treatment is abstinence. This is done via a multidisciplinary approach involving urologists, psychiatrists, social workers, and other relevant disciplines. Intravesical therapies, such as hyaluronic acid instillation and botulinum toxin injection, are emerging options that have shown promising results. Upper tract protection in the form of long-term percutaneous nephrostomies may save the patient from suffering from chronic renal failure.

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