

REVIEW

Systematic review and meta-analysis on management of acute urinary retention

PD Yoon, V Chalasani and HH Woo

BACKGROUND: Acute urinary retention (AUR) is a common urological emergency. In this article, we review the current literature and present a structured summary in management of AUR.

METHODS: A systematic review was conducted using the keywords 'acute AND retention AND urin*' within the title in search engines including Medline, EMBASE and EBM Review. The obtained literature was manually reviewed by the primary author (PDY) and was further refined by confining the subject to management of AUR. Exclusion criteria included paediatric and female population studies, case reports, reviews, surveys, economical assessment and articles on AUR in prostate cancer and post-operative patients.

RESULTS: Total of 54 articles met our inclusion and exclusion criteria. The trial without catheter (TWOC) post-immediate catheterisation is widely practiced although there remains a significant variability in terms of type and duration of catheterisation required, use of concurrent medical therapy or post-catheterisation management. Our systematic review and subsequent meta-analysis has shown superiority of α_1 -adrenergic receptor blockers over placebo in achieving successful voiding in patients with AUR. Suprapubic catheter (SPC) is an alternative to urethral catheterisation (indwelling catheter (IDC)) and may provide several advantages. Clean intermittent self-catheterisation may be a safe and useful option for patients with AUR until their definitive management. The overall long-term outcome of in-and-out catheterisation remains promising in selected patients. Surgery is an end point in patients with unsuccessful TWOC as well as in those with significant lower urinary tract symptoms post-successful TWOC.

CONCLUSIONS: We recommend use of α_1 -adrenergic receptor blockers before TWOC and discourage emergency operative management. Use of SPC over IDC in AUR is debatable. Duration of catheterisation is controversial but <3 days is a safe option in avoiding catheterisation-related complications. Although TURP remains the current gold standard, there has been an emergence of newer operative management utilising laser techniques.

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INTRODUCTION

Acute urinary retention (AUR) is a common urological emergency associated with inability to empty the bladder to completion.¹ It is a complex presentation that may represent various pathological processes and more than 10% of men in their 70's and a third in their 80's are expected to be affected by this condition within 5 years.²

AUR results from both acute and chronic illnesses including iatrogenic causes such as medications and surgical interventions.³ In most cases, it is difficult to identify the triggering event and AUR is attributed to BPH. Irrespective of the cause, AUR has a debilitating impact on both the patient's quality of life and the health system. It has been shown that patients with AUR present to emergency with higher pain scores, which are almost comparable to renal colic (7.7 vs 8.3).⁴ There is also a substantial economical impact beyond their initial presentation.⁴

Recent epidemiological data report increasing presentations with AUR. An analysis of 3.7 million American patients presenting to a Californian emergency departments between 2007 and 2010 showed a 36% increase over this period.⁵ This contrasts to an earlier study from the Hospital Episode Statistics database in

England, which showed decreasing trend for primary AUR by 7% between 1998 and 2003.⁶

The resurgence of AUR is an inevitable major public health issue in the western world with increased life expectancy leading to more hospital presentations of the elderly population.⁷ There has been an associated increase in the volume of literature published on the management of AUR with ongoing expansion of research activities. We have reviewed the current literature and present a structured summary on the management of AUR.

MATERIALS AND METHODS

A systematic review was conducted using the keywords 'acute AND retention AND urin*' within the title in search engines including Medline, EMBASE and EBM Review. Studies from the non-English language literature were included; however, studies on paediatric and female populations were excluded. This search was further refined by confining the subject to management of AUR. The obtained literature was manually reviewed by the primary author (PDY) and case reports/series, reviews, surveys, economical assessment and articles on AUR in prostate cancer patients and post-operative patients were excluded from our

review as we aimed to focus on the immediate management of AUR. A further reference search was performed if the articles were meta-analysis articles to cite the original articles. All references to levels of evidence reflect those defined by the Oxford Centre for Evidence-based Medicine.⁸

Where adequate numbers of control trials were available, meta-analysis was performed on specific management options. Intention to treat model was used and *P*-value of < 0.05 was considered as significant.

RESULTS

The initial Medline search yielded 43 articles. Further EMBASE and EBM Review search added 11 more articles to our archives when duplicates were excluded (Figure 1). These articles were reviewed including their references to obtain information on management of AUR, which are further categorised and presented below.

Aetiology and pathogenesis

The causes of AUR can be largely classified into spontaneous AUR (sAUR) which has no triggering events, and is mostly secondary to the natural history of BPH, and precipitated AUR (pAUR) where there is an identifiable trigger. The Reten-World Study of 6074 men showed that sAUR was the major presentation comprising 70.6% of all casualty presentations with AUR.⁹ The differentiation is important clinically as surgical management in pAUR group is much less common.^{10,11} Precipitating events of pAUR include recent surgery, medication, alcohol intake, urinary tract infection and faecal impaction. The prevalence of each underlying precipitant varies according to the surveyed region around the world.^{9,12}

The exact aetiology of AUR is unclear and is thought to be multi-factorial. It is postulated that a combination of mechanical (BPH, urethral stricture, clot retention) or dynamic obstruction (increased alpha-adrenergic activity, prostatic inflammation), bladder over-distension (immobility, constipation, drugs inhibiting bladder contractility, high alcohol intake) and neuropathic mechanisms (diabetic cystopathy, multiple sclerosis) are attributable for AUR.^{1,13,14} The pathogenesis of AUR has been extensively researched and number of mechanisms such as prostatic infarction, abnormal alpha adrenergic activity, decrease in the

stromal-epithelial ratio, disruption of neurotransmitter modulation and prostatic inflammation have all been implicated.^{1,14}

Immediate management and trial without catheter

The immediate management of AUR is bladder decompression by catheterisation followed by post-catheterisation management, which may include surgery. The international trend on immediate management of AUR by trial without catheter (TWOC) post-immediate catheterisation is widely practiced, evidenced by multiple cross-sectional studies and surveys worldwide.^{9,12,15,16} However, there remains a significant variability within and among countries in the optimal management of AUR in terms of type and duration of catheterisation required, use of concurrent medical therapy or post-catheterisation management.¹⁰

A French cross-sectional study of 2618 men showed men with no significant post-void residual volume (< 50 ml), less severe lower urinary tract symptoms and no previous episodes of AUR were more likely to undergo a successful TWOC.³ Men presenting with sAUR were less likely to undergo a TWOC as compared to those with pAUR (66 vs 89%).³ The former group was also more likely to proceed with elective (22.1%) or immediate (7.5%) BPH-related surgery as compared with those presenting with pAUR (7.1 and 1.1%, respectively; *P* < 0.001).³ A lower success rate of TWOC is seen in older patients of age > 70 years, those with an enlarged prostate (> 50 ml), higher PSA (> 3 ng/ml) and large drained volume at time of catheterisation (> 1 l).¹² These results are supported by a separate prospective study by Mahadik and colleagues, who confirmed a significant association between TWOC outcome and age (*P* = 0.0053), and prostate volume on ultrasound (*P* = 0.0427).

The duration of catheterisation before TWOC is controversial. There were five separate studies identified in our review discussing the duration of catheterisation (Table 1). All five studies were not able to show a consistent relationship between successful voiding and duration before TWOC. Two studies showed decreased success of TWOC in longer durations although statistically not significant, especially if they were receiving alpha 1-adrenoceptor blockers (α -blockers).^{3,12} In contrast, a multi-national study suggested that catheterisation for > 3 days was associated with a slightly greater success rate of TWOC (61 vs 64%, *P* = 0.03 in univariate analysis).⁹ Two other randomised control trials (RCTs) supported prolonged catheterisation.^{17,18} Taube *et al*'s study was limited to duration less than 3 days hence it is difficult to compare with other studies.¹⁸ Prolonged catheterisation for > 3 days was also associated with greater complications and prolonged hospitalisation as compared with patients who were catheterised for 3 days or less (33.8 vs 19.7%, *P* < 0.001).⁹

History taking and examination of the patient remain critical. This should be followed by immediate bladder decompression by catheterisation to relieve their discomfort. A digital rectal examination is performed to determine BPH or prostatic carcinoma. Urinalysis and cultures to exclude evidence of infection or haematuria are a crucial part of the assessment. Adjunct information to identify the cause of retention and to begin appropriate treatments should be sought. Drained volume post-catheterisation, renal ultrasound and blood tests including renal function and inflammatory markers can help to predict the severity of AUR and subsequent management. If causes are still unclear, then CT scans, functional investigations such as urodynamic studies, MRI scanning to rule out neurological pathology or cystoscopy to rule out structural abnormalities such as strictures can follow to identify the patient's pathology.¹⁹

The patient will require admission if there are evidence of urosepsis, gross haematuria, significant residual volume of > 1 l or acute renal impairment.¹⁹ Significant post-catheterisation diuresis will require intravenous fluid support and any patients with atypical symptoms such as severe abdominal pain or neurological

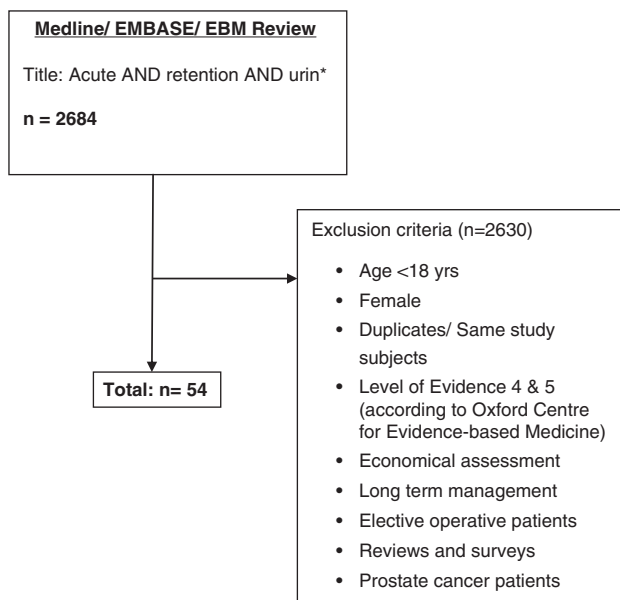


Figure 1. Search strategy.

Table 1. TWOC with the duration of catheterisation

Study (year)	Subjects	Duration	Successful voiding (%)	Complication (%)	Miscellaneous
Park <i>et al.</i> ¹²	262	< 5 days	81	NA	
		> 5 days	77		
		LE: IIb	NA		
Fitzpatrick <i>et al.</i> ⁹	6074	< 3 days	61	19.7	Multivariate analysis: duration statistically not significant Includes Desgrandchamps <i>et al.</i> 's population ³
		> 3 days	64	33.8	
		LE: IIa	$P=0.03$	$P < 0.001$	
Desgrandchamps <i>et al.</i> ³	2618	< 3 days	59.5	2.2	Significant less hospital stay in < 3 days group
		> 3 days	40.5	6.5	
		LE: IIb	NA	$P < 0.001$	
Djavan <i>et al.</i> ¹⁷	114	0 days	44	NA	Larger (> 1.2 L) retained volumes likely to benefit from prolonged catheterisation
		2 days	51		
		7 days	62		
		LE: Ib	NA		
Taube <i>et al.</i> ¹⁸	60	0 days	27.8	NA	Larger (> 900 ml) retained volumes likely to fail TWOC
		1 days	20.0		
		2 days	36.4		
		LE: Ib	NA		

Abbreviations: LE, level of evidence; NA, not stated; TWOC, trial without catheter.

symptoms should be admitted for further investigations. Those with disabilities or social issues where managing urethral catheterisation at home is a challenge also warrant admission.¹⁹

Use of suprapubic catheter, clean intermittent self-catheterisation and in-and-out catheterisation

Suprapubic catheter (SPC) is an alternative to urethral catheterisation and may provide several advantages over its urethral counterpart. Horgan *et al.*²⁰ reported in his case-control trial of 86 patients (LE: IIIb), a lower rate of urinary tract infection and lower incidence of urethral stricture at 3 years follow-up with SPC when compared with urethral catheterisation.²⁰ SPC also has the theoretical advantage of avoiding damage to the urethra and bladder neck. There is also the added benefit of permitting a trial of void by spigotting the catheter before removal avoiding the need for re-catheterisation.⁹

There are significant risks associated with insertion of SPC. Some studies have reported a 2.5% risk of bowel injury and a 1.8% 30-day mortality rate.²¹ Those having undergone previous lower abdominal surgery or having neurological diseases have been identified to be at increased risk of complications.²¹ Higher rates of haematuria are also reported following SPC when compared with urethral catheterisation.³ The British Association of Urological Surgeons' SPC practice guidelines recommend SPC insertion either using an open technique or with the adjunct of imaging to exclude the presence of bowel loops in the intended catheter track if such risks are present.²² This has led to the trend of SPC insertion being performed only by an experienced medical practitioner and therefore preferential use of urethral catheterisation over SPC in emergency departments.¹³

A feasibility trial (LE: IIIb) of clean intermittent self-catheterisation after a short period of indwelling catheter (IDC) (mean = 2.6 days) on 50 patients had a higher success of voiding compared with the IDC group (56 vs 25%).²³ The author notes study's limitation on lack of randomisation has led to clean intermittent self-catheterisation group being much younger and having smaller prostates where they are more expected to have a successful TWOC.²³ Nonetheless, the article shows some evidence that clean intermittent self-catheterisation may be a safe and useful option for patients with AUR until their definitive management (e.g., surgery).

In-and-out catheterisation is a TWOC strategy for treatment in AUR management also being trialled around the world.

Retrospective analysis of 515 AUR patients (LE: IIb) managed with in-and-out catheterisation and IDC showed comparable success rate of TWOC (25.1 vs 30.3%) with post-residual volume being the most important predictor for failure.²⁴ The most frequent complication of intermittent catheterisation is urinary tract infection.²⁵ The overall long-term outcome remains promising in selected patients.

Alpha 1-adrenoceptor blockers

The rationale for using α -blockers before a TWOC is based on the pathophysiology of BPH-related AUR secondary to sudden stimulation of α_1 -adrenergic receptors, which result in prostatic smooth muscle contraction and hence an increase in bladder outlet resistance.²⁶ By decreasing the sympathetic tone by blocking the receptor, bladder outlet resistance is reduced, followed by successful TWOC.

A Cochrane review of five RCTs showed statistically significant benefit of α -blockers compared with placebo in contributing to successful TWOC.²⁷ Tamsulosin (400 mcg daily), alfuzosin (10 mg daily) and newer selective α -blockers such as silodosin (8 mg daily) and doxazosin (4 mg daily) have been shown to be effective in successful TWOC.²⁸⁻⁴⁰ In a French cross-sectional study of 2618 men, 79% of subjects were treated with α -blockers during the time of catheter insertion and the TWOC success rate was significantly higher in men who received medical therapy before TWOC (53.0 vs 39.6%).³ Similar findings are reported by Reten-World Study Group where prevalent use of α -blockers (86%) worldwide is noted with the result doubling success rate of TWOC.⁹

Our systematic review was able to identify 13 RCTs (LE: Ib) and subsequent meta-analysis has shown superiority of α -blockers over placebo in achieving successful voiding in patients with AUR (Table 2, Figure 2).

5-Alpha reductase inhibitors

5-Alpha reductase inhibitors are often used in primary prevention of AUR in patients with BPH. In contrast to its long-term benefits, there are no immediate effects on increasing success rates of TWOC and therefore is not indicated in the immediate management of AUR. Nonetheless, it has been shown to modify disease progression of BPH and to reduce recurrence of AUR as well as lower urinary tract symptoms after 3-6 months of therapy.⁴¹⁻⁴³

Table 2. Successful voiding with use of alpha-blockers

Study (year)	Agent	Subjects (n)	Duration of catheter	Successful voiding (%)		P
				α -Blocker	Placebo	
Kumar et al. ²⁸	Silodosin (8 mg OD)	60	3 days	76.7	36.7	0.002
Tiong et al. ³¹	Alfuzosin (10 mg OD)	67	2 days	60	34	0.036
McNeill et al. ²⁹	Alfuzosin (10 mg OD)	357	3 days	61.9	47.9	0.012
Shah et al. ³²	Alfuzosin SR (5 mg BD)	62	Min 3 doses or 36 h	50.0	57.1	NA
McNeill et al. ³³	Alfuzosin SR (5 mg BD)	81	24 h	55.0	29.3	0.03
Maldonado-Avila et al. ³⁴	Alfuzosin (10 mg OD)	90	4 days	35.2	26.3	0.662
Agrawal et al. ³⁵	Tamsulosin (400 mcg OD)	150	3 days	43.2	36	NA
	Alfuzosin (10 mg OD)			66		
Lucas et al. ³⁰	Tamsulosin (400 mcg OD)	149	Up to 8 doses	70	24.3	0.011
	Alfuzosin (10 mg OD)			45.3		
Hua et al. ³⁶	Tamsulosin (400 mcg OD)	72	3 days	61	28	< 0.01
Al-Hashimi et al. ³⁷	Alfuzosin (10 mg OD)	245	3 days	62.3	32.7	0.0001
Prieto et al. ³⁸	Doxazosin (4 mg OD)	47	30 days	56.5	54.2	0.87
Lorente et al. ³⁹	Doxazosin (4 mg OD)	40	7 days	60	25	0.02
Perepanova et al. ⁴⁰	Doxazosin (4–8 mg OD)	36	Up to 3 days	63.3	16.7	NA

Abbreviation: NA, not stated.

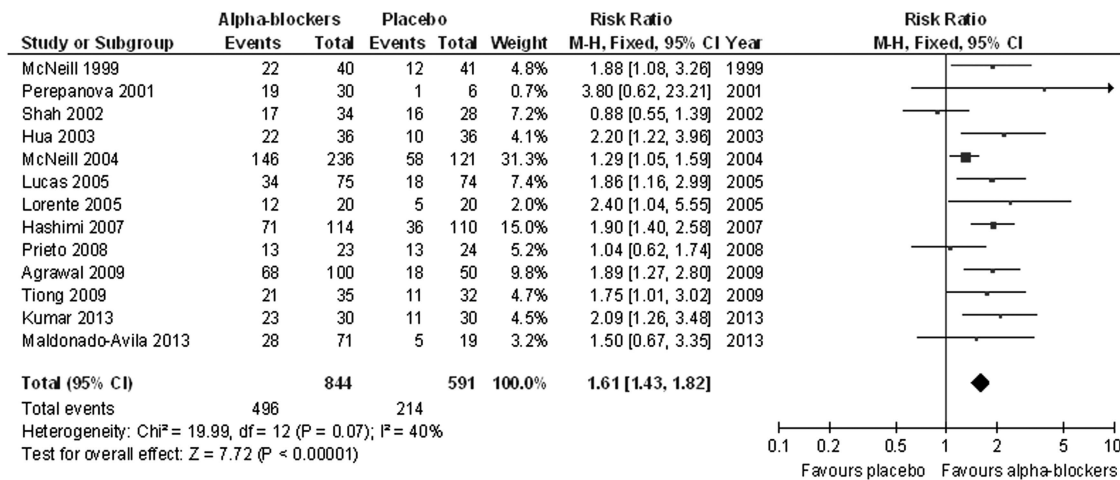


Figure 2. Forest plot illustrating superiority of alpha blockers over placebo in achieving successful voiding in patients with acute urinary retention.

Surgical intervention

There is a role for surgical intervention in patients with unsuccessful TWOC as well as in those with significant lower urinary tract symptoms post-successful TWOC. TURP patients have significantly lower rates of subsequent urinary retention⁴⁴ and it is generally considered to be the end point for AUR. Those patients with a large prostate size (> 50 ml) and a high serum PSA level during AUR (> 10 mcg/L) are more likely to undergo future surgical intervention.⁴⁵ A prospective study of 40 conservatively managed AUR patients followed up to 24 months showed that only 22 (55%) voided spontaneously after TWOC and remained to do so.⁴⁶ PLESS study found that 67% of patients who suffered from sAUR eventually underwent BPH-related surgery, as compared with 35% of patients presenting with pAUR over a 4-year interval.⁴³ Previous studies have reported only 23–28% of men with AUR will void successfully after a TWOC and have no need for a prostatectomy in the short to medium term.^{18,47} Lo et al.⁴⁵ showed that although α -blockers increased the success rate of TWOC, approximately half of the patients required additional intervention within 5 years. Similar findings are reported by the ALFAUR study, of those commenced on alfuzosin 10 mg once

daily after AUR, 17.1% of patients still required surgical treatment within 6 months.²⁹

The decision to offer prostatectomy should be undertaken on the basis of persistent symptoms or decreased quality of life rather than the diagnosis of AUR alone. Recent UK studies have shown that immediate surgical management after AUR was associated with greater risks.^{7,48} Surgical intervention especially in the failed TWOC group and in older patients, in the presence of a urinary catheter, leads to an increased risk of sepsis, which potentially contributes to the observed increase in operative morbidity.¹⁵ The UK National Prostatectomy Audit (LE: 11b) showed that compared with elective surgery for obstructive symptoms alone, emergency surgery following AUR with a catheter *in situ* resulted in a 3.0-fold increase in the risk of post-operative death at 30 days, a 2.5-fold increase in the risk of requiring a transfusion, a 2.0-fold increase in the risk of operative complications and a 1.6-fold increase in post-operative complications.⁴⁸

Although TURP remains the current gold standard, there has been an emergence of newer technology using laser techniques. We have identified five papers discussing management of AUR using laser which presents varying results. The CLaSP randomised trial (LE: 1b) comparing TURP with Nd:YAG laser assisted prostatectomy in 148 men showed significantly higher treatment

Table 3. Recommendation on management of AUR

Recommendation	Highest level of evidence	Grade of recommendation
Use of SPC over IDC in AUR	Ila and IIlb (heterogeneous)	Option
Duration of catheterisation (< 3 days)	Ib and Ila (heterogeneous)	Option
Use of α -adrenergic receptor blockers before TWOC	Ia	Standard
Emergency operative management should be avoided	Ila	Recommendation
Factors influencing TWOC: larger prostate size (> 50 ml), older age (> 70 years), greater drained volume at catheterisation (> 1), higher previous IPSS score	Ib	

Abbreviations: AUR, acute urinary retention; IDC, indwelling catheter; IPSS, International Prostate Symptom Score; SPC, suprapubic catheter; TWOC, trial without catheter.

failure rate for the laser than the TURP group (9.5 vs 1.4%, $P=0.029$).⁴⁹ Holmium: YAG Laser Resection of Prostate technique showed mean postoperative catheterisation time of 1.5 days and only 3 men (8.3%) required a catheter for more than 48 h (LE: IV).⁵⁰ Thulium laser resection for AUR is also supported by a Chinese prospective case series (LE: IV) with relatively low perioperative adverse events and recatheterisation rate of 3.8%.⁵¹ An Australian group showed that PVP (photoselective vaporisation of the prostate) is an efficacious and safe treatment modality for AUR (LE: IIb).⁵² Chinese group also demonstrated this in their 42 post-PVP patients with only two patients experiencing recurrent urinary retention (LE: IIb).⁵³

Miscellaneous

More research is being performed to combine agents for the management of AUR. For instance, combination of tamsulosin and ketoconazole was tested in a recent RCT (LE: Ib), where patients with AUR due to BPH had more successful TWOC after 7 days of combination therapy compared with control group of tamsulosin therapy alone (77.35 vs 58.84%, $n=106$, $P=0.01$).⁵⁴

The use of transurethral microwave thermotherapy has been advocated in one study as a useful option for the patient with AUR who is not a suitable candidate for surgery with 94% (29/31) of patients regaining their voiding abilities by 4 weeks (LE: IV).⁵⁵ Use of a bio-absorbable braided urethral stents is also being piloted in regard to its efficacy and safety and has yielded promising results when combined with dutasteride (LE: IV).⁵⁶ All subjects ($n=10$) were able to void short term and 50% of subjects were still able to spontaneously void at 3 months.⁵⁶

CONCLUSION

We recommend following on the management of AUR based on our systematic review and meta-analysis of the literature (Table 3.) From our review, it was evident that there is high variability in the management of AUR worldwide, especially in early management. There is a need for further standardisation and guidelines to harmonise the management of AUR. Further research is hence warranted for development of economical, efficient and evidence-based practice in management of AUR for the patients as well as the health system.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

- Kalejaiye O, Speakman MJ. Management of acute and chronic retention in men. *Eur Urol Suppl* 2009; **8**: 523–529.
- Jacobsen SJ, Jacobson DJ, Girman CJ, Roberts RO, Rhodes T, Guess HA *et al*. Natural history of prostatism: risk factors for acute urinary retention. *J Urol* 1997; **158**: 481–487.

- Desgrandchamps F, De La Taille A, Doublet JD. The management of acute urinary retention in France: a cross-sectional survey in 2618 men with benign prostatic hyperplasia. *BJU Int* 2006; **97**: 727–733.
- Thomas K, Oades G, Taylor-Hay C, Kirby RS. Acute urinary retention: what is the impact on patients' quality of life? *BJU Int* 2005; **95**: 72–76.
- Groves HK, Chang D, Palazzi K, Cohen S, Parsons JK. The incidence of acute urinary retention secondary to BPH is increasing among California men. *Prostate Cancer Prostatic Dis* 2013; **16**: 260–265.
- Cathcart P, van der Meulen J, Armitage J, Emberton M. Incidence of primary and recurrent acute urinary retention between 1998 and 2003 in England. *J Urol* 2006; **176**: 200–204; discussion 4.
- Armitage JN, Sibanda N, Cathcart PJ, Emberton M, van der Meulen JH. Mortality in men admitted to hospital with acute urinary retention: database analysis. *Br Med J* 2007; **335**: 1199–1202.
- Phillips B, Ball C, Sackett D, Badenoch D, Straus S, Haynes B *et al*. Oxford Centre for Evidence-based Medicine Levels of Evidence. University of Oxford; 2009 (cited 14 April 2014); Available from: <http://www.cebm.net/oxford-centre-evidence-based-medicine-levels-evidence-march-2009/>.
- Fitzpatrick JM, Desgrandchamps F, Adjali K, Gomez Guerra L, Hong SJ, El Khalid S *et al*. Management of acute urinary retention: a worldwide survey of 6074 men with benign prostatic hyperplasia. *BJU Int* 2012; **109**: 88–95.
- Emberton M, Fitzpatrick JM. The Reten-World survey of the management of acute urinary retention: preliminary results. *BJU Int* 2008; **101**: 27–32.
- Fitzpatrick JM, Kirby RS. Management of acute urinary retention. *BJU Int* 2006; **97**: 16–20.
- Park K, Kim SH, Ahn SG, Lee SJ, Ha US, Koh JS *et al*. Analysis of the treatment of two types of acute urinary retention. *Korean J Urol* 2012; **53**: 843–847.
- Hallett JM, Stewart GD, McNeill SA. The management of acute urinary retention: treating the curse of the aging male. *Curr Bladder Dysfunct Rep* 2013; **8**: 242–249.
- Thomas K, Chow K, Kirby RS. Acute urinary retention: a review of the aetiology and management. *Prostate Cancer Prostatic Dis* 2004; **7**: 32–37.
- Manikandan R, Srirangam SJ, O'Reilly PH, Collins GN. Management of acute urinary retention secondary to benign prostatic hyperplasia in the UK: a national survey. *BJU Int* 2004; **93**: 84–88.
- Ku JH, Kim SW, Paick JS. Questionnaire survey of urologists' initial treatment practices for acute urinary retention secondary to benign prostatic hyperplasia in Korea. *Urol Int* 2006; **76**: 314–320.
- Djavan B, Shariat S, Omar M, Roehrborn C, Marberger M. Does prolonged catheter drainage improve the chance of recovering voluntary voiding after acute urinary retention (AUR). *Eur Urol* 1998; **33**: 110.
- Taube M, Gajraj H. Trial without catheter following acute retention of urine. *Br J Urol* 1989; **63**: 180–182.
- Teoh JY, Kan CF, Tsui B, Chiu PK, Man CY, Hou SS *et al*. Ambulatory care program for patients presenting with acute urinary retention secondary to benign prostatic hyperplasia. *Int Urol Nephrol* 2012; **44**: 1593–1599.
- Horgan AF, Prasad B, Waldron DJ, O'Sullivan DC. Acute urinary retention. Comparison of suprapubic and urethral catheterisation. *Br J Urol* 1992; **70**: 149–151.
- Ahluwalia RS, Johal N, Kouriefs C, Kooiman G, Montgomery BS, Plail RO. The surgical risk of suprapubic catheter insertion and long-term sequelae. *Ann R Coll Surg Engl* 2006; **88**: 210–213.
- Harrison SC, Lawrence WT, Morley R, Pearce I, Taylor J. British Association of Urological Surgeons' suprapubic catheter practice guidelines. *BJU Int* 2011; **107**: 77–85.
- Patel MI, Watts W, Grant A. The optimal form of urinary drainage after acute retention of urine. *BJU Int* 2001; **88**: 26–29.
- Ko YH, Kim JW, Kang SG, Jang HA, Kang SH, Park HS *et al*. The efficacy of in-and-out catheterization as a way of trial without catheterization strategy for treatment

- of acute urinary retention induced by benign prostate hyperplasia: variables predicting success outcome. *NeuroUrol Urodyn* 2012; **31**: 460–464.
- 25 Wyndaele JJ, Brauner A, Geerlings SE, Bela K, Peter T, Bjerklund-Johanson TE. Clean intermittent catheterization and urinary tract infection: review and guide for future research. *BJU Int* 2012; **110**: E910–E917.
 - 26 Caine M, Raz S, Zeigler M. Adrenergic and cholinergic receptors in the human prostate, prostatic capsule and bladder neck. *Br J Urol* 1975; **47**: 193–202.
 - 27 Zeif HJ, Subramonian K. Alpha blockers prior to removal of a catheter for acute urinary retention in adult men. *Cochrane Database Syst Rev* 2009, CD006744.
 - 28 Kumar S, Tiwari DP, Ganesamoni R, Singh SK. Prospective randomized placebo-controlled study to assess the safety and efficacy of silodosin in the management of acute urinary retention. *Urology* 2013; **82**: 171–175.
 - 29 McNeill SA, Hargreave TB, Roehrborn CG. Alfuzosin 10 mg once daily in the management of acute urinary retention: results of a double-blind placebo-controlled study. *Urology* 2005; **65**: 83–89. discussion 9–90.
 - 30 Lucas MG, Stephenson TP, Nargund V. Tamsulosin in the management of patients in acute urinary retention from benign prostatic hyperplasia. *BJU Int* 2005; **95**: 354–357.
 - 31 Tiong HY, Tibung MJ, Macalalag M, Li MK, Consiigliere D. Alfuzosin 10 mg once daily increases the chances of successful trial without catheter after acute urinary retention secondary to benign prostate hyperplasia. *Urol Int* 2009; **83**: 44–48.
 - 32 Shah T, Palit V, Biyani S, Elmasry Y, Puri R, Flannigan GM. Randomised, placebo controlled, double blind study of alfuzosin SR in patients undergoing trial without catheter following acute urinary retention. *Eur Urol* 2002; **42**: 329–332; discussion 32.
 - 33 McNeill SA, Daruwala PD, Mitchell ID, Shearer MG, Hargreave TB. Sustained-release alfuzosin and trial without catheter after acute urinary retention: a prospective, placebo-controlled. *BJU Int* 1999; **84**: 622–627.
 - 34 Maldonado-Avila M, Manzanilla-Garcia HA, Sierra-Ramirez JA, Carrillo-Ruiz JD, Gonzalez-Valle JC, Rosas-Nava E et al. A comparative study on the use of tamsulosin versus alfuzosin in spontaneous micturition recovery after transurethral catheter removal in patients with benign prostatic growth. *Int Urol Nephrol* 2014; **46**: 687–690.
 - 35 Agrawal MS, Yadav A, Yadav H, Singh AK, Lavania P, Jaiman R. A prospective randomized study comparing alfuzosin and tamsulosin in the management of patients suffering from acute urinary retention caused by benign prostatic hyperplasia. *Indian J Urol* 2009; **25**: 474–478.
 - 36 Hua LX, Wu HF, Sui YG, Chen SG, Xu ZQ, Zhang W et al. [Tamsulosin in the treatment of benign prostatic hyperplasia patients with acute urinary retention]. *Natl J Androl* 2003; **9**: 510–511.
 - 37 Al-Hashimi MMR. Alfuzosin 10 mg once daily in the management of acute urinary retention of benign prostatic hyperplasia: a double-blind, placebo-controlled study. *Curr Urol* 2007; **1**: 28–34.
 - 38 Prieto L, Romero J, Lopez C, Ortiz M, Pacheco JJ. Efficacy of doxazosin in the treatment of acute urinary retention due to benign prostate hyperplasia. *Urol Int* 2008; **81**: 66–71.
 - 39 Lorente GJ, Cañis SD, Arango TO, Bielsa GO, Cortadellas AR, Gelabert MA. [Doxazosin in the gastrointestinal therapeutic system (GITS) formulation and trial without catheter after acute urinary retention due to BPH. Dose increase action on recovery effect]. *Actas Urol Esp* 2004; **28**: 32–37.
 - 40 Perepanova TS, Kamalov AA, Siniukhin VN, Gorokhnov AV, Khazan PL, Orlova EV. [Doksazozin "Cardura" in acute urinary retention caused by benign prostatic hyperplasia]. *Urologiia* 2001; **3**: 18–20. PMID: 11505534.
 - 41 Marberger MJ. Long-term effects of finasteride in patients with benign prostatic hyperplasia: a double-blind, placebo-controlled, multicenter study. PROWESS Study Group. *Urology* 1998; **51**: 677–686.
 - 42 Roehrborn CG, Bruskewitz R, Nickel GC, Glickman S, Cox C, Anderson R et al. Urinary retention in patients with BPH treated with finasteride or placebo over 4 years. Characterization of patients and ultimate outcomes. The PLESS Study Group. *Eur Urol* 2000; **37**: 528–536.
 - 43 McConnell JD, Bruskewitz R, Walsh P, Andriole G, Lieber M, Holtgrewe HL et al. The effect of finasteride on the risk of acute urinary retention and the need for surgical treatment among men with benign prostatic hyperplasia. Finasteride Long-Term Efficacy and Safety Study Group. *N Engl J Med* 1998; **338**: 557–563.
 - 44 Flanigan RC, Reda DJ, Wasson JH, Anderson RJ, Abdellatif M, Bruskewitz RC. 5-year outcome of surgical resection and watchful waiting for men with moderately symptomatic benign prostatic hyperplasia: a Department of Veterans Affairs cooperative study. *The Journal of urology*. 1998; **160**: 12–16; discussion 6–7.
 - 45 Lo KL, Chan MC, Wong A, Hou SM, Ng CF. Long-term outcome of patients with a successful trial without catheter, after treatment with an alpha-adrenergic receptor blocker for acute urinary retention caused by benign prostatic hyperplasia. *Int Urol Nephrol* 2010; **42**: 7–12.
 - 46 Kumar V, Marr C, Bhuvangiri A, Irwin P. A prospective study of conservatively managed acute urinary retention: prostate size matters. *BJU Int* 2000; **86**: 816–819.
 - 47 Hastie KJ, Dickinson AJ, Ahmad R, Moisey CU. Acute retention of urine: is trial without catheter justified? *J R Coll Surg Edinburgh* 1990; **35**: 225–227.
 - 48 Pickard R, Emberton M, Neal DE. The management of men with acute urinary retention. National Prostatectomy Audit Steering Group. *Br J Urol* 1998; **81**: 712–720.
 - 49 Chacko KN, Donovan JL, Abrams P, Peters TJ, Brookes ST, Thorpe AC et al. Transurethral prostatic resection or laser therapy for men with acute urinary retention: the ClasP randomized trial. *J Urol* 2001; **166**: 166–170. discussion 70–1.
 - 50 Kabalin JN, Mackey MJ, Cresswell MD, Fraundorfer MR, Gilling PJ. Holmium: YAG laser resection of prostate (HoLRP) for patients in urinary retention. *J Endourol* 1997; **11**: 291–293.
 - 51 Zhuo J, Wei HB, Zhao FJ, Sun F, Han BM, Sun XW et al. Two-micrometer thulium laser resection of the prostate-tangerine technique for patients with acute urinary retention. *Lasers Med Sci* 2013; **29**: 1093–1098.
 - 52 Chung A, Woo HH. Photoselective vaporization of the prostate with the 120 W lithium triborate laser for the treatment of acute urinary retention. *Prostate* 2012; **1050**: 58–121.
 - 53 Fu WJ, Gao JP, Hong BF, Yang Y, Cai W, Zhang L. Photoselective laser vaporization prostatectomy for acute urinary retention in China. *J Endourol* 2008; **22**: 539–543.
 - 54 Elbendary M, El-Gamal O, Soliman M, Tawfik A, Taha M. Role of combined use of ketoconazole and tamsulosin in management of acute urinary retention due to benign prostatic obstruction (a randomized controlled trial). *Prostate Cancer Prostatic Dis* 2013; **16**: 362–366.
 - 55 Djavan B, Seitz C, Ghawidel K, Basharkhah A, Bursa B, Hruby S et al. High-energy transurethral microwave thermotherapy in patients with acute urinary retention due to benign prostatic hyperplasia. *Urology* 1999; **54**: 18–22.
 - 56 Kotsar A, Isotalo T, Juuti H, Mikkonen J, Leppiniemi J, Hanninen V et al. Biodegradable braided poly(lactic-co-glycolic acid) urethral stent combined with dutasteride in the treatment of acute urinary retention due to benign prostatic enlargement: a pilot study. *BJU Int* 2009; **103**: 626–629.