

Urinary retention

Jalesh N. Panicker, Ranan DasGupta, Sohier Elneil and Clare J. Fowler

Introduction

Impairment of bladder emptying may manifest as complete or partial urinary retention, and be either acute or chronic. The conditions under which retention occur are many and varied, indicating there must be many different causes which effect the same end result.

Acute complete urinary retention is not uncommon following surgery irrespective of the operation site and is attributed to pain and the effects of postoperative analgesia, with full recovery of voiding when these effects wear off. Although complete retention can occur acutely, it may be due to a high post-void residual volume, of which the patient may or may not be aware. Partial retention may be discovered incidentally or as a result of investigation of a patient reporting the sensation of incomplete voiding in association with voiding difficulty or a poor stream. When a voiding disorder occurs in conjunction with detrusor overactivity, as commonly occurs with spinal cord disease, it may be conceptually helpful to think of the high residual volume as the result of “incomplete emptying.”

Patients with retention may present to a urologist, uro-gynecologist or neurologist.

Causes of urinary retention

The underlying causes of urinary retention may be either structural or functional (Table 19.1).

Structural causes

Once a diagnosis has been made, most structural causes are amenable to surgical correction. Urological or gynecological assessment includes taking a history, genital and pelvic examination, and where indicated, urodynamic studies and possibly specialized imaging

of the outflow tract. Urethrocystoscopy is then usually performed.

Mechanical causes in men generally result from an anatomical obstruction to the bladder outflow, due for example to an enlarged prostate gland, urethral stricture, or even a phimosis. Prolonged obstruction (chronic retention) can eventually result in detrusor “failure” or hypocontractility. As a general rule it is advisable for a man with a longstanding neurological condition to be investigated urologically before ascribing new bladder symptoms to his neurological disease: a urethral stricture may develop some years after prolonged catheterization during a period of unconsciousness or paralysis in intensive care.

In women, there is no specific diagnosis of bladder outlet obstruction, as occurs in the men. However, external factors can obstruct the urethra. These include urethral diverticulae, uterine and cervical fibroids and vaginal wall cysts.

Functional urinary retention with associated neurological dysfunction

Spinal cord disease is a common cause of incomplete bladder emptying although this usually occurs in combination with detrusor overactivity so that the clinical picture is dominated by urgency incontinence. Sometimes, however, the impaired emptying may be the more prominent part of the disorder, resulting occasionally in complete retention. An acute spinal cord injury causing “spinal shock” will result in detrusor areflexia lasting some weeks (Chapter 15). Be the spinal cord pathology causing bladder dysfunction acute or chronic, its other neurological features will be readily apparent: it is extremely unusual for a spinal lesion to cause bladder dysfunction without

Table 19.1. Causes for urinary retention

Mechanical (anatomical)		
	Congenital malformations	Posterior urethral valves
	Tumors	Prostate and bladder
		Gynaecological, e.g. leiomyomas, pregnancy, vaginal wall cysts
		Urethral, e.g. urethral diverticulum or cysts
	Stenosis and strictures	Urethral stricture, bladder neck stenosis
	Calculi	Bladder or urethral
	Urogenital prolapse	
Functional <i>Neurological causes</i>		
	Detrusor external sphincter dyssynergia and poorly sustained detrusor contraction	Spinal cord injury or disease
	Detrusor areflexia or hypocontractility	Multiple system atrophy
		Lesion of conus medullaris or spinal roots
		Pure autonomic failure
		Radical pelvic surgery
<i>Non-neurological causes</i>		
	Primary failure of urethral sphincter relaxation	Fowler's syndrome (FS)
	Medication	Anticholinergic drugs or those with anticholinergic activity
		Opiates
	Primary detrusor myogenic failure	

there being long tract signs on neurological examination. Normal lower limb-evoked potentials may be reassuring, as will a normal MRI of the spine, an investigation which is frequently performed but rarely reveals unsuspected abnormalities in this context.

Incomplete bladder emptying has been identified as a feature that can be used to distinguish between MSA and Parkinson's disease [1] and an increasing post-micturition residual volume has been demonstrated as disease progresses in MSA [2] (Chapter 13). Just occasionally complete urinary retention can be a presenting symptom of MSA, although on careful clinical examination other neurological features will be apparent.

The neurological concept of "upper" and "lower motor neuron" lesion, which is fundamental for

understanding neurogenic skeletal muscle weakness, is not directly applicable to neurogenic bladder disorders. Whereas damage to an anterior horn cell in the cord or its motor axon in a ventral root or peripheral nerve will result in denervated striated muscle and flaccid paralysis, a sacral root lesion does not produce detrusor denervation. This is because the S₂–S₄ roots contain the preganglionic parasympathetics destined for ganglia in the pelvis from which short postganglionic fibers originate to innervate the detrusor smooth muscle (Chapter 1) (Fig. 19.1).

So it is that subsacral cord or cauda equina lesions (Chapters 15 and 17) produce an insensate "decentralized" bladder which may exhibit poor compliance or detrusor overactivity, presumably due to preserved

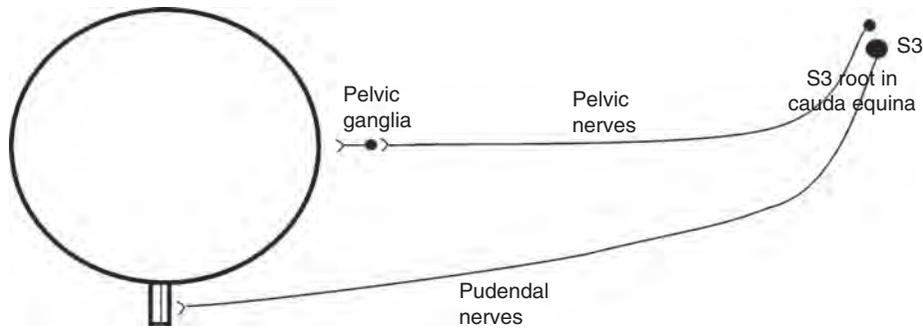


Fig. 19.1. Whereas sphincter denervation is a consequence of sacral root injury, root injury or damage to the pelvic nerves in the pelvis produces a “decentralized” bladder since the postganglionic innervation is intact.

urothelial-detrusor reflexes and continuing intact sympathetic innervation, rather than an acontractile detrusor and urinary retention. Retention can, however, result from damage to the ganglia as may occur in the condition of pure autonomic failure with ganglionic autoantibodies, or surgical damage to the ganglia and postganglionic fibers during radical pelvic surgery (Chapter 18). Incomplete emptying or complete retention can also result from the small fiber involvement of diabetic or amyloid neuropathy which may affect the pre- and postganglionic innervation (Chapter 18).

What may either be a neuropathy confined to the visceral innervation, or in infants a myopathy, can cause “visceral enteropathy.” This can present as chronic idiopathic pseudo-obstruction (CIPO), a rare syndrome characterized by gross distension of predominantly the small bowel without any anatomical or mechanical obstruction. Bladder dysfunction has been reported in 10–69% of patients with CIPO [3–5]. Urodynamic investigations reveal similar changes to those seen in diabetic cystopathy including detrusor hypocontractility, increased residual volume and decreased bladder sensation [3]. Many are able to void with the Valsalva maneuver or using catheters.

In men, there is an uncommon condition where painless urinary retention presents without a mechanical cause or associated neurological disorder. They have neither accompanying constipation nor sexual dysfunction and extensive investigation fails to reveal any underlying abnormality. It has been speculatively proposed that this disorder is due to some abnormality of the intrinsic afferent innervation, possibly loss of the “myofibroblast” or interstitial cells, thought to be an integral part of the bladder stretch-sensing mechanism [6], although any evidence for this is

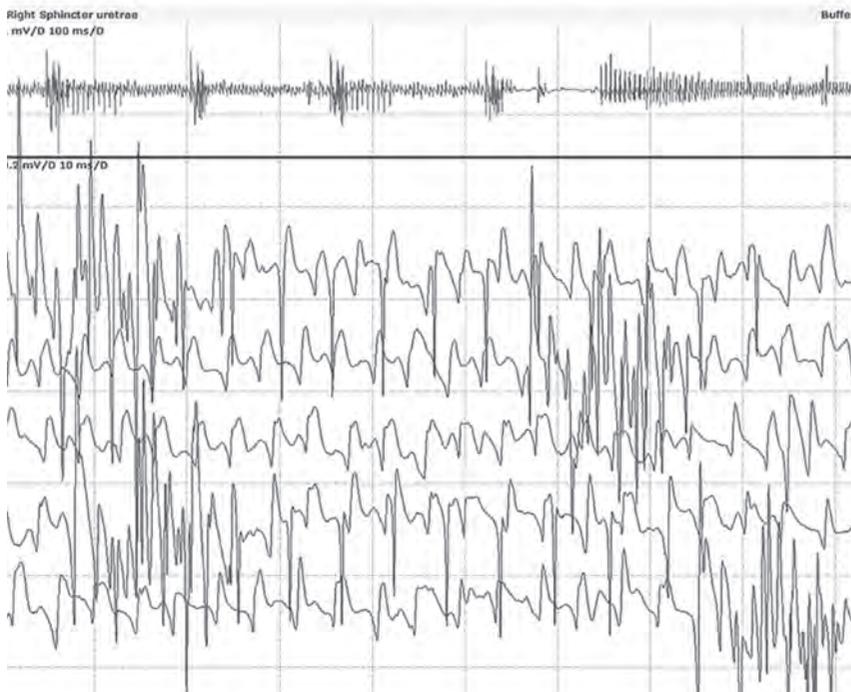
currently lacking. Presumably, this same condition makes up a proportion of the women with unexplained urinary retention.

Fowler’s syndrome (FS)

Urinary retention in young women in whom no urological, gynecological or neurological abnormality can be identified present a diagnostic dilemma. Women experiencing otherwise unexplained urinary retention are more numerous than men and in a young woman a primary failure of sphincter relaxation (FS) should be suspected. Previously, isolated urinary retention in young women in whom no abnormalities on routine tests could be found was purported to be of psychogenic or hysterical origin [7–13], although a disorder of sphincter relaxation in young women has been recognized for several years. Moore observed urethral sphincter hypertrophy during cystoscopy in a series of women with voiding dysfunction [14] and Raz observed elevated urethral closure pressures in a group of young women with urinary retention and postulated that their retention was due to spasticity of the striated urethral sphincter or pelvic floor [15]. Fowler and colleagues then recorded myotonia-like electromyographic (EMG) activity in the striated urethral sphincter of women presenting with urinary retention [16] and proposed that the urinary retention was due to a primary impairment of sphincter relaxation [17].

Although the EMG activity sounds superficially like myotonia, detailed analyses show that the characteristic descending sound is due to a decelerating component of a complex repetitive discharge [18] (Fig. 19.2A). When a number of generators of this type of activity are heard, the sound has been likened

(a)



(b)



Fig. 19.2. Electromyographic recording from the striated urethral sphincter of a woman in complete urinary retention. A. "Decelerating burst." B. "Complex repetitive discharge." When heard over the audio output of the EMG machine, it is likened to the sound of helicopters.

to that of underwater recordings of whale song [19]. Complex repetitive discharges without deceleration produce a sound like helicopters over the audio-amplifier of the EMG machine (Fig. 19.2B). Jitter analysis of the components of the complex repetitive discharges shows that this is so low that it must be due to ephaptic transmission between muscle fibers [18] generating repetitive, circuitous self-excitation. It is this abnormal activity which is thought to prevent relaxation of the sphincter and cause urinary retention or voiding dysfunction [18]. Other studies have demonstrated an association between complex repetitive discharges and increased post-void residual urine [20] and voiding dysfunction [21].

At the time of the original description of FS, many of the patients were observed to be hirsute, obese and to have menstrual irregularities and there appeared to be a clinical association with polycystic ovaries (PCO) [17]. This association is now no better understood than when the observation was first made, and although the coincidence of PCO and retention is by no means inevitable, a hormonal basis for the EMG abnormality seems likely and it has been proposed that it is the result of a hormonally dependent channelopathy [22]. The same type of sphincter disorder has not been found in men with otherwise unexplained retention. According to the recent work of O'Connell and colleagues [23] the distal urethra is a constituent part of the clitoris, forming the "clitro-urethrovaginal complex" [24] and clearly the distal urethra has major sex-determined attributes.

Clinical features and investigations

A retrospective study by Swinn et al. defined the characteristic features of FS [25]. Patients are typically young post-menarche females who become unable to void and present with painless urinary retention, having a demonstrated residual volume exceeding 1 l at some stage in the evolution of their disorder (Table 19.2). Although they may experience pain if bladder distension becomes extreme, they do not report the expected urgency at such a large bladder capacity. Straining does not help emptying and intuitively women feel they must promote sphincter relaxation to void by whatever means they can.

The women often report that there has been an antecedent event prior to the onset of their retention, such as an obstetric, gynecological or urological

Table 19.2. Fowler's syndrome: clinical features and laboratory findings

Clinical history	Female
	Aged between onset of menarche and menopause
	No evidence of urological, gynecological or neurological disease
	Retention with a volume in excess of 1000 ml
	No sense of urinary urgency despite high bladder volumes
	Straining does not help emptying
	Sense of "something gripping" or difficulty on removing catheter
	No history of urological abnormalities in childhood or associated abnormalities of the urinary tract
	Association with polycystic ovarian syndrome and endometriosis
Laboratory findings	
	Raised urethral pressure (>50% expected value for age)
	Increased sphincter volume (>1.8 ml on USS assessment)
	Characteristic urethral sphincter EMG

surgical procedure using regional or general anesthesia. That the surgical procedure can be distant from the pelvis and as minor as wisdom teeth extraction suggests the significant factor is the general anesthetic. In some cases it is possible to elicit a prior history of poor voiding with an interrupted flow with which the woman may have been unconcerned but indicating at least some pre-existing abnormality. Why then a transient event such as a general anesthetic should precipitate retention which does not resolve remains unknown and has undoubtedly been the cause of a number of medicolegal problems.

If a trial without a catheter fails, the woman is usually introduced to clean intermittent self-catheterization and her loss of sensation of urgency and their large capacity mean she can go for long intervals without catheterizing. However, catheterization is often painful, particularly on removing the catheter, with many women complaining of a sensation of

“something gripping” as the catheter is withdrawn. The discomfort with self-catheterization appears to be much greater for these women than is reported by similarly aged young women with multiple sclerosis and it is not uncommon for the difficulties to be so extreme that a suprapubic catheter is required. This is clearly a thoroughly unsatisfactory arrangement for an otherwise healthy young woman.

Routine cystometry demonstrates a large-capacity bladder without the usual sensations during the filling phase, and filling is often stopped at 500 ml on grounds of safety although the subject's capacity is much greater. The patient is then unable to initiate voiding and no rise in detrusor pressure observed.

The diagnostic investigation is urethral sphincter EMG using a concentric needle electrode (see Chapter 4), to detect the abnormality previously described. However, despite paraurethral injection of local anesthetic first, which may itself be painful, this test is uncomfortable and furthermore the information obtained is qualitative rather than quantitative: “is there or is there not abnormal EMG activity?” It provides only limited information about the severity of abnormality and expected resulting dysfunction, and it is sometimes difficult to be sure that “sufficient abnormality” has been found to account for a woman's complete urinary retention. The urethral pressure does however give insight into the functional abnormality. Using an infusion technique (withdrawal of an 8 Fr urethral catheter at 2 mm/s while infusing saline at 2 ml/min), maximum urethral closure pressure (MUCP) can be measured (Fig. 19.3) and typically women with FS are found to have resting values in excess of 100 cm of water [26]. The formula of $92 - \text{age (in years)}$ is used to derive the expected pressure, based on the work of Edwards and Malvern [27]. Wiseman et al. [28] also proposed that ultrasound measurement of sphincter volume was helpful to detect the hypertrophy of the striated sphincter resulting from sustained overactivity; but operator variability in this measurement has restricted its usefulness in the diagnostic algorithm for these patients.

Pathogenesis of retention

Initially the findings seemed to suggest that urinary retention in these young women was simply the result of chronic outflow obstruction owing to poor sphincter relaxation. However the restoration of detrusor

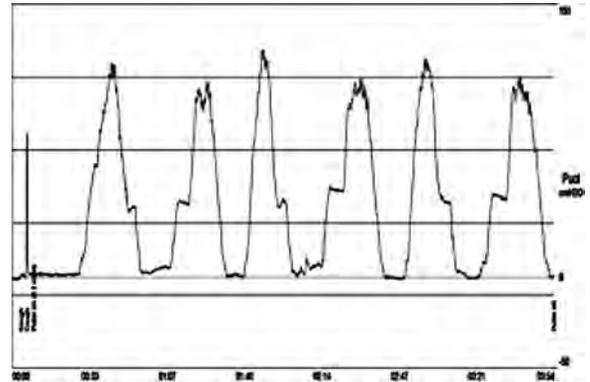


Fig. 19.3. UPP in woman with Fowler's syndrome.

contractions following sacral neuromodulation (SNM) and the evidence from functional brain imaging suggests the underlying mechanism of the retention is more complicated. That contraction of the striated urethral sphincter can inhibit detrusor contraction and suppress bladder afferents is known from animal experiments [29], although this has been little studied as it is a difficult phenomenon to investigate in animals. We do know that in health, urethral afferents are hard-wired in the spinal cord to suppress sensation, inhibit bladder activity and moderate ascending bladder signals [30] (Chapter 1). This is the neural basis for the “pro-continence reflex” whereby voluntary contraction of the sphincter reduces urgency, and it is enhancement of this reflex that is the basis for physiotherapy exercises to encourage pelvic floor contractions to control urgency incontinence. Feed forward from the guarding reflex may further activate the pro-continence reflex in health, both mechanisms combining to maintain bladder control as the bladder fills. In FS it is hypothesized that extreme involuntary sphincter contraction results in accentuation of the pro-continence reflex to the point that bladder sensation is suppressed and detrusor contraction completely inhibited. Certainly an absence of sensation with gross bladder filling is characteristic of this condition and further implies that signals from the bladder reaching the brain are abnormally weak. The recent surprising results of an fMRI research study provide confirmation of this hypothesis [31].

Repeated bladder filling and emptying of only 50 ml at the baseline “bladder empty” condition showed widespread negative responses to bladder infusion (appearing blue in Fig. 19.4) in six women

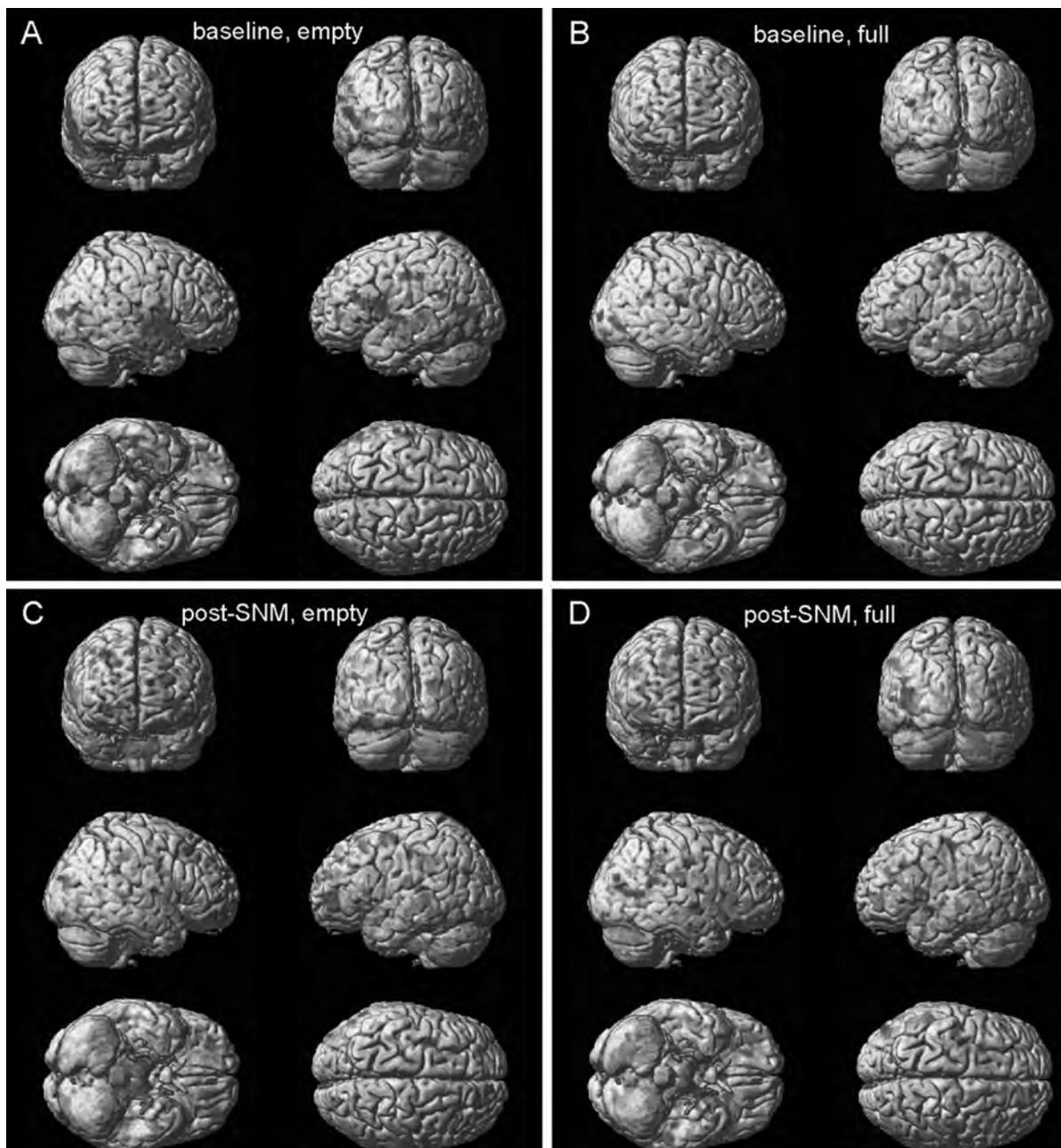


Fig. 19.4. Functional MRI study in Fowler's syndrome. Responses to bladder infusion for the six women, rendered (projected) on the brain surface. Red = activation; blue = negative response. A. Session at baseline with a near-empty bladder. B. at baseline with a full bladder. C. After SNM and a near-empty bladder. D. After SNM and a full bladder. Positive responses (red) indicate activation by bladder infusion. Negative responses (blue) indicate that the fMRI signal is smaller during infusion than during withdrawal. For the session at baseline with an empty bladder (Fig. 19.2A), the brain responses to bladder infusion (relative to withdrawal) were almost exclusively negative. See plate section for color version.

with FS, quite different from the activations seen in "normal" individuals. Negative responses indicate that the fMRI signal is smaller during infusion than during withdrawal, the interpretation of this finding

being that bladder filling in these women elicits abnormally strong urethral afferent signals that inhibit bladder afferent activity reducing input to (and so deactivating) the periaqueductal gray (PAG)

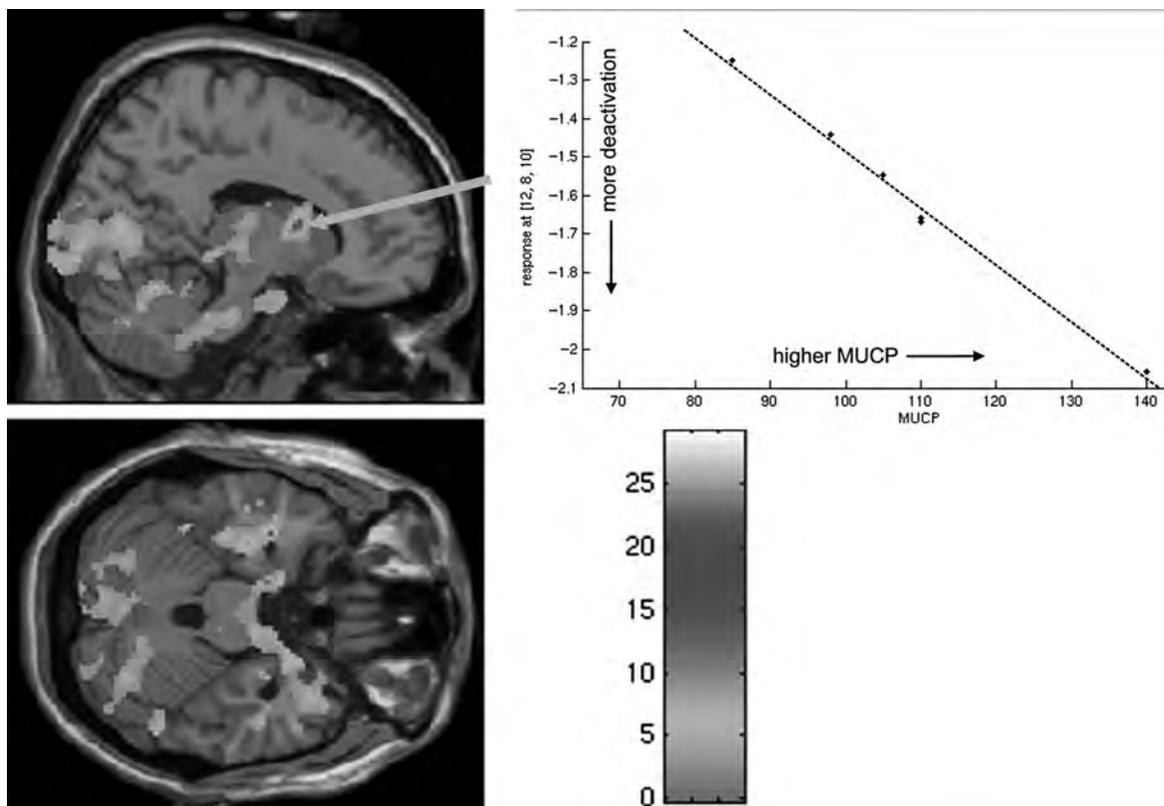


Fig. 19.5. Correlation between the defect in the interoception of filling, i.e. an abnormal negative response, and the maximum urethral closure pressure (MUCP), a proxy measure of the abnormality of sphincter activity, in the individual subjects. See plate section for color version.

and higher centers. Furthermore a correlation was demonstrated between the defect in the interoception of filling (i.e. the abnormal negative responses) and the maximum urethral closure pressure, a proxy measure of the abnormality of sphincter activity, in the individual subjects (Fig. 19.5).

Our understanding of the mechanism of action of SNM in FS has developed through a number of experimental approaches including urodynamics, electrophysiological, brain imaging and clinical observation. An elegant demonstration of the restoration of sensation and its timing in relation to the start of neuromodulation was described by Swinn et al. Within hours of switching on the stimulator for SNM, bladder sensations return and the woman is able to void again. In a study that measured the voided volumes and the post-micturition residual volumes before and after the onset of neuromodulation, there continued to be increased volumes voided

(and concomitant decreased residual volume) over 48–72 hours [32] (Fig. 19.6).

A study by DasGupta and Fowler included assessment of striated sphincter EMG and MUCP before and after SNM, and showed no overall change in these parameters in women with restored voiding [33]. Urodynamic data from that study showed that the restoration of voiding is not due to changes in sphincter overactivity but an improvement in detrusor contractility: a surrogate measurement of “work done” by the detrusor suggested that the restored voiding was achieved by overcoming obstructed bladder outflow.

A PET study suggested SNM probably restored voiding in women with FS by resetting brainstem function [34]. What was demonstrated with PET imaging was that with SNM afferent activity reached the midbrain [34], and more recently with functional magnetic resonance imaging (fMRI) [31] it reached

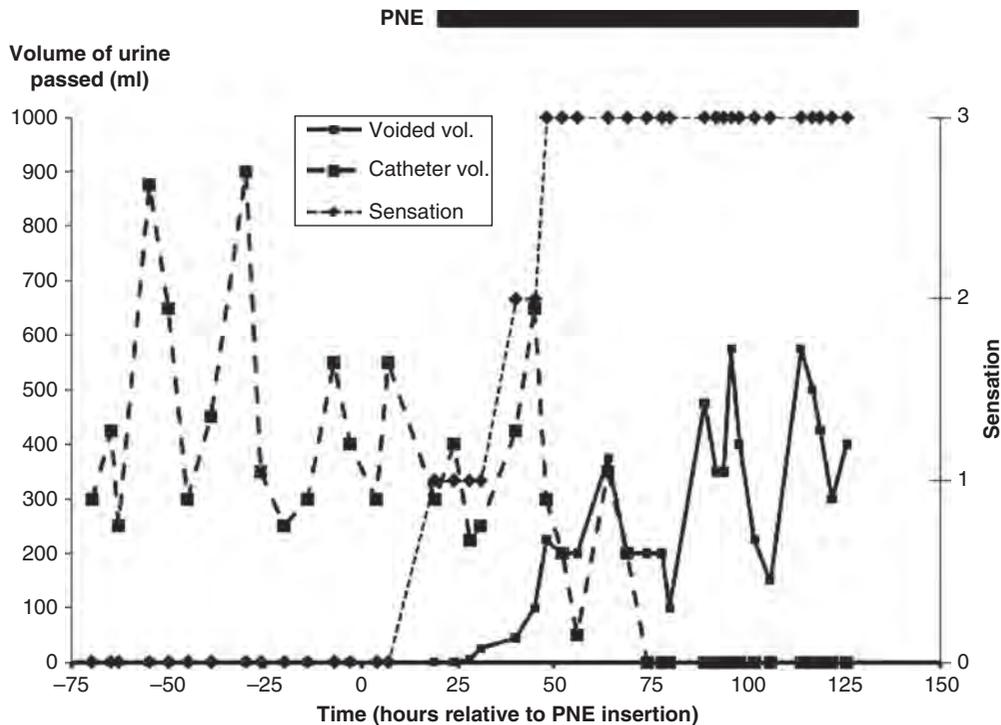


Fig. 19.6. Within hours of switching on the stimulator for sacral neuromodulation (SNM) bladder sensations return and the woman is able to void again. A study that measured the voided volumes and the post-micturition residual volumes before and after the onset of neuromodulation showed that there continued to be increased volumes voided (and concomitant decrease in residual volume) over 48–72 hours. From [32], with permission.

the PAG (Fig. 19.7). It is therefore hypothesized that SNM blocks the urethral inhibition of afferent information flow from the bladder, thus re-enabling voiding.

Opiates and voiding dysfunction

Although the theory outlined above provides the main basis for understanding urinary retention in young women with FS, the role of medication in causing retention, opiates in particular, has recently become the focus of attention. Drugs with anticholinergic activity (e.g. antipsychotic drugs, antidepressant agents and anticholinergic respiratory agents), α -adrenoceptor agonists, benzodiazepines, non-steroidal anti-inflammatory drugs (NSAIDs) and calcium channel antagonists [35] are well known to affect voiding but we have recently become increasingly aware of the effect of opiates in causing a failure to void. Although notorious as a potent cause of constipation, the role of opiates as a cause of urinary retention seems to be less well recognized. Previous

studies have demonstrated significant urodynamic findings in patients receiving intrathecal and intravenous opiates, including impaired bladder sensation, detrusor hypocontractility and increased bladder capacity with normal urethral pressures [36, 37]. The effect may be dose-related as evidenced by the increased risk of postoperative retention with patient-controlled analgesia as compared to intramuscular opioids [38]. Tramadol in particular has been shown to have a potent effect in reducing detrusor overactivity in experimental animal models [39, 40]. The Netherlands Pharmacovigilance Foundation reported five cases where there was a temporal association between transient voiding dysfunction or urinary retention with the use of tramadol [41]. Animal studies suggest that the activation of μ opioid receptors in the PAG region of the midbrain inhibit detrusor contractions, thus resulting in urinary retention [42]. Both men and women taking these medications are similar to women with FS in that they lack sensations of urgency but by contrast they can usually empty to completion.

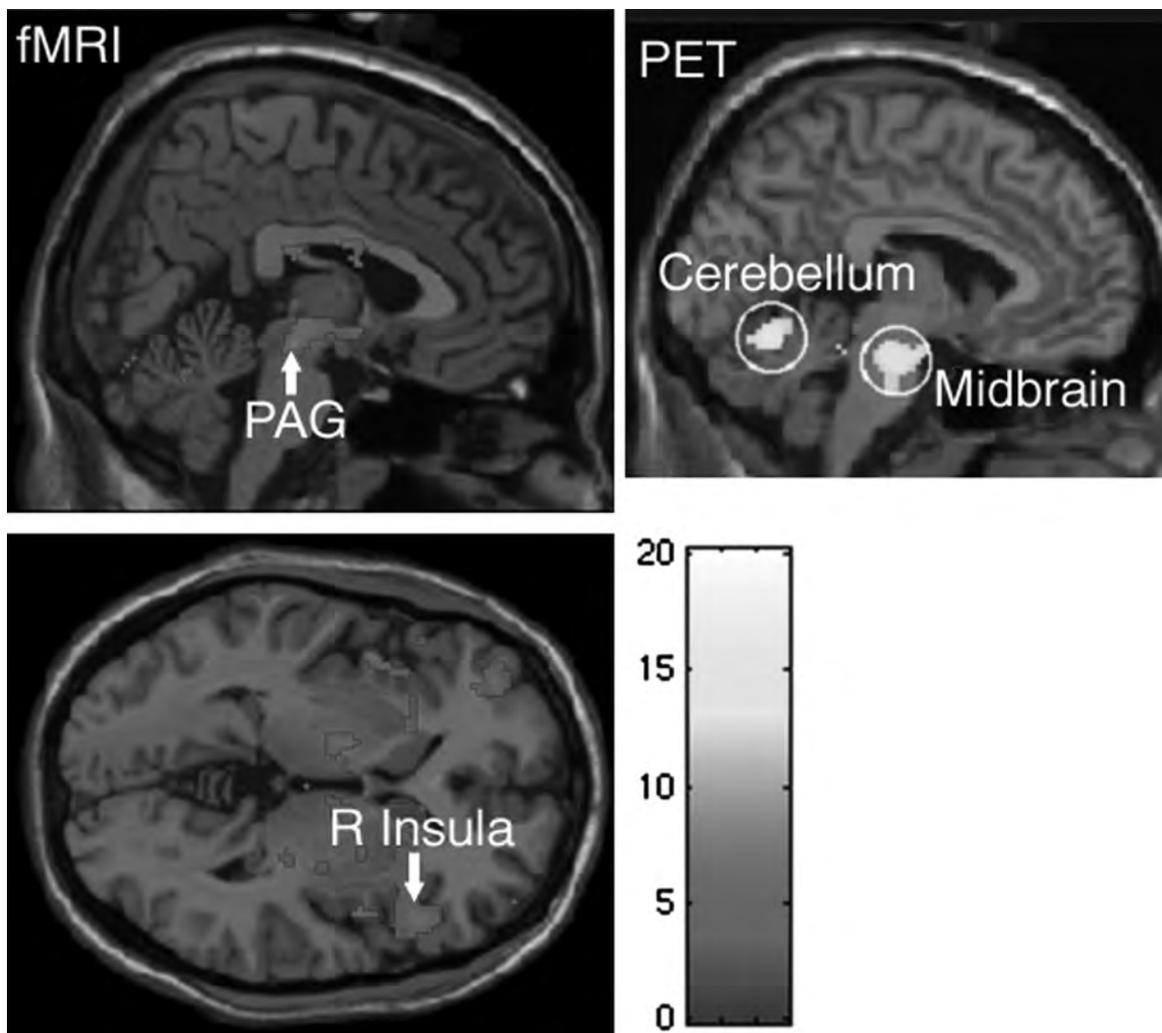


Fig. 19.7. PET imaging showed that with SNM afferent activity reached the midbrain [34] and more recently with functional magnetic resonance imaging (fMRI) [31] the PAG and right insula showed activation. Reproduced with permission. See plate section for color version.

The effect of these medications on a patient with “incomplete” FS is not clear but it may well be synergistic and precipitate complete retention. In a prospective study of 61 referrals to our department for investigation and management of urinary retention, the cause could be identified in only 19. However, 24 of the 61 patients were using significant doses of opiates and in 34 of them, no other cause for urinary retention could be identified [43] (Fig. 19.8). This recent observation explains a longstanding difficulty for the originator of FS which has been the defence of the proposal that there is an organic cause for urinary retention in young women who do not

have neurological or urological disease, some of whom have personality traits which many medical practitioners regard as “manipulative or immature.” This has led to the observation that “Fowler’s syndrome does not keep good company.” In retrospect women taking high doses of opiates almost certainly comprised a cohort of such cases and the possibility that the effect of opiates is to accentuate the pathophysiological consequences of an overactive sphincter may explain why 29% of those diagnosed with FS on the basis of abnormal sphincter EMG and an elevated MUCP were also taking opiates [43] (Fig. 19.8).

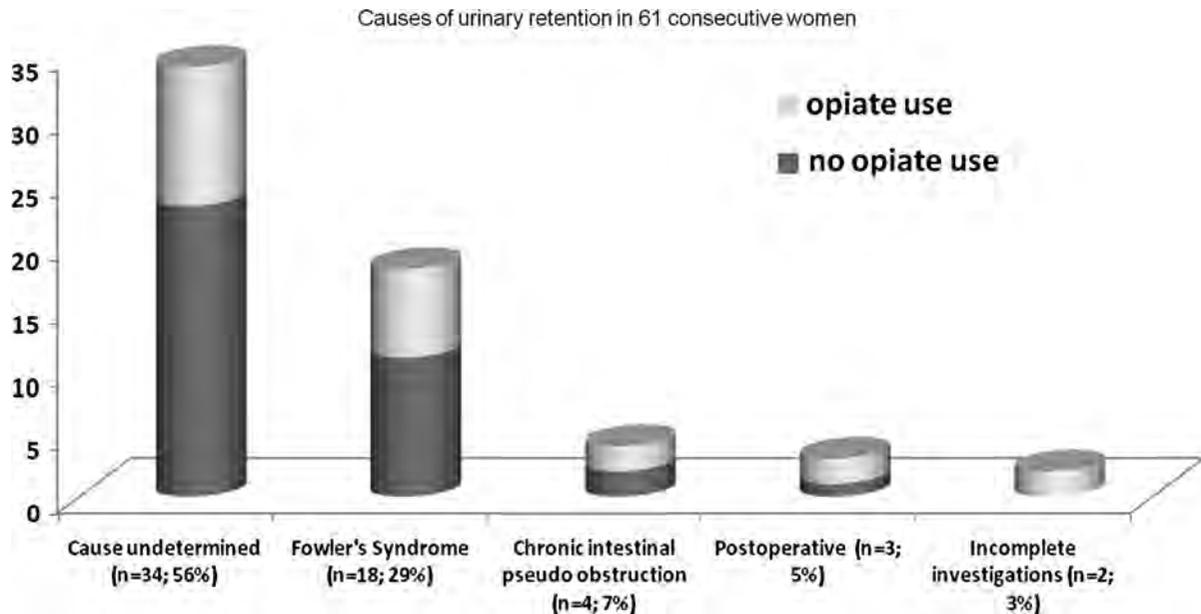


Fig. 19.8. Opiate use in a prospective study of women presenting with urinary retention (n = 61) [43].

Recently, Elneil et al. performed a retrospective analysis of the outcome of “two-stage” sacral neuromodulation in treating 100 women with chronic urinary retention, 25 of whom were on opiate medications prescribed by their general practitioners or pain physicians for symptomatic management of chronic back, pelvic or abdominal pain. Eight of these women had been diagnosed with FS on the basis of their history, a raised UPP and abnormal sphincter EMG and a further eight had a suitable history and raised UPP but had not had a sphincter EMG test.

It is now being hypothesized that FS results in excessive levels of endogenous encephalins, possibly at the level of the sacral spinal cord [43], and that in some patients this may be compounded by the effect of exogenous opiates. Sacral neuromodulation, but not pudendal nerve stimulation, somehow successfully counteracts that pathological condition.

Outcomes of SNM

In the analysis of our initial cohort of 60 women who underwent percutaneous nerve evaluation (PNE) and subsequent implant, when followed up with a mean interval of 7 years, 70% were voiding spontaneously [44]. This is in keeping with the findings from other centers of the longer-term efficacy of SNM as a treatment for non-obstructive retention, van Voskuilen

et al. showing 76.2% efficacy at 70.5 months [45] and Elhilali et al. showing efficacy of 78% at 77 months [46]. Importantly, De Ridder and colleagues showed that women with urinary retention due to FS had a better outcome from SNM at five years than those without an abnormal sphincter EMG (72% vs. 46%) [47]. Our results were similar, with 78% versus 43% efficacy, respectively [44].

Having changed to the “two-stage” procedure (see Chapter 7) in 2004, a recent, medium-term follow-up of 100 women showed that the efficacy of the first stage of the implant was 81% and an abnormal sphincter EMG was a predictor for responsiveness [48]. Stage 2 was carried out in 77 patients and complete voiding was restored in 54 patients, improved bladder emptying in 9 patients but failure in 14 patients. Of the 77 women, only 49 had had sphincter EMG but all had had UPP measurement. An elevated UPP was found to predict a good response to stage 2 but the EMG findings were inadequately powered to demonstrate an effect. A new surgical intervention was required in 40 patients either because of leg pain or pain in relation to the battery site, lead displacement or fracture, loss of efficacy or battery site infection.

As mentioned above, 25% of this cohort was being treated with opiates but the use of opiates was shown to have no effect on the outcome of stage 1 or stage

2, nor was it a determining factor for the need for revision surgery. A deduction that can be made from the observation that those taking and those not taking opiates had a comparable response to SNM suggests that its mechanism of action is likely to involve an anti-inhibitory effect of neurotransmitters common in both groups, possibly at opiate receptors in the cord or PAG. Recently Chen et al. [49] have demonstrated that the inhibitory effect of pudendal nerve stimulation on bladder reflexes in experimental cats can be influenced by naloxone, suggesting an inhibitory role of endogenous opioids as a mediator for the stimulation effect. However, pudendal nerve stimulation at standard frequencies has been found not to be effective in restoring voiding in women with retention (personal communication, Dr. Spinelli), suggesting that pudendal nerve stimulation and sacral neuromodulation produce a fundamentally different effect on the neural control of micturition. It is postulated that SNM may specifically counteract an excessive level of endogenous, and sometimes additional exogenous, opiate transmitters.

Management of chronic urinary retention and SNM

The alternatives for management of chronic urinary retention in women are limited. Many patients are treated with α -blockers, urethral dilatation or urethrotomy with little long-term success. Working on the principle that a phosphodiesterase inhibitor might increase nitric oxide availability in the sphincter and thus improve sphincter relaxation, we treated five women with FS in a placebo-controlled trial with sildenafil but unfortunately without benefit [50]. Although an early study of the effect of injection of botulinum toxin into the striated urethral sphincter [51] failed to restore voiding in women with FS, there is some evidence that this is an intervention worth revisiting.

Whilst no pharmacological has yet been discovered to be effective, many women face the prospect of indefinite, often uncomfortable intermittent catheterization or a permanent drainage procedure (either an indwelling catheter or a surgical urinary diversion procedure). This is an unsatisfactory solution for young women and their problem is commonly compounded by a deep dissatisfaction because they may have had no explanation as to why they continue to have chronic urinary retention. With increasing

access to the internet, more patients and their relatives are becoming aware that SNM is an intervention that can restore voiding for some and they naturally seek out the opportunity to be treated by this intervention. The result is that both women and men with chronic retention are being referred to centers that offer this treatment, although only a small proportion may be considered suitable.

That SNM restores voiding in FS is well established [32], its long-term efficacy has been shown to be greatest in women with FS [47], and furthermore we now have a scientific basis for understanding how it works in this condition [31, 34]. The efficacy of SNM in other causes of retention (most of which are of unknown cause) is much less certain [52]. This presents a problem when counseling patients, although many centres operate a policy that it is reasonable to carry out a PNE, or nowadays more likely stage 1 with timed lead, to test for efficacy in each individual wishing to be considered for long-term SNM. Certainly the indications for SNM seem to be widening and its effect in men with non-surgical urinary retention deserves further investigation.

Selection of patients with retention for SNM

It is assumed that patients have had structural or neurological diagnosis excluded or at least uncovered. Although a diagnosis of FS is now established as a predictor for a good outcome for SNM [32, 47, 48], sphincter needle EMG is not an easy test for the patient or electromyographer and the test is not widely performed outside academic centers. However, urethral pressure profile is a standard urodynamic investigation and it is recommended that this is more widely used in the preoperative assessment of women with retention. It will be elevated in women with a primary disorder of sphincter relaxation (i.e. FS) but abnormally low in women who have urinary retention as a result of a damage to innervation of the sphincter and detrusor. Consideration of patients taking opiates, which may either be the cause alone or a contributing factor to urinary retention [43], is a difficulty. Clearly if the dosage is such that the medication appears to be affecting daily function or addictive behaviour patterns are evident, then steps to stop or reduce it, although difficult to achieve, would seem to be a better medical approach than SNM.

Since SNM it is a resource-intensive procedure requiring a number of hospital visits and an

expensive implant, patients should be selected carefully for their ability to understand the implications of what the treatment involves and their own capability to manage possible adverse events.

References

- Hahn K, Ebersbach G. Sonographic assessment of urinary retention in multiple system atrophy and idiopathic Parkinson's disease. *Mov Disord* 2005;**20**:1499–502.
- Ito T, Sakakibara R, Yasuda K, et al. Incomplete emptying and urinary retention in multiple-system atrophy: when does it occur and how do we manage it? *Mov Disord* 2006;**21**:816–23.
- Lapointe SP, Rivet C, Goulet O, Fekete CN, Lortat-Jacob S. Urological manifestations associated with chronic intestinal pseudo-obstructions in children. *J Urol* 2002;**168**(4 Pt 2):1768–70.
- Mousa H, Hyman PE, Cocjin J, Flores AF, Di Lorenzo C. Long-term outcome of congenital intestinal pseudoobstruction. *Dig Dis Sci* 2002;**47**:2298–305.
- Vargas JH, Sachs P, Ament ME. Chronic intestinal pseudo-obstruction syndrome in pediatrics. Results of a national survey by members of the North American Society of Pediatric Gastroenterology and Nutrition. *J Pediatr Gastroenterol Nutr* 1988;**7**:323–32.
- Wiseman OJ, Fowler CJ, Landon DN. The role of the human bladder lamina propria myofibroblast. *BJU Int* 2003;**91**:89–93.
- Knox S. Psychogenic urinary retention after parturition resulting in hydronephrosis. *Br Med J* 1960;**2**:1422–4.
- Margolis GJ. A review of literature on psychogenic urinary retention. *J Urol* 1965;**94**:257–8.
- Allen TD. Psychogenic urinary retention. *South Med J* 1972;**65**:302–4.
- Barrett DM. Psychogenic urinary retention in women. *Mayo Clin Proc* 1976;**51**:351–6.
- Montague DK, Jones LR. Psychogenic urinary retention. *Urol* 1979;**13**:30–5.
- Bird JR. Psychogenic urinary retention. *Psychother Psychosom* 1980;**34**:45–51.
- Bassi P, Zattoni F, Aragona F, et al. La retention psychogene d'urine chez la femme: aspects diagnostiques et therapeutiques. *J d'Urologie* 1988;**94**:159–62.
- Moore T. Bladder-neck obstruction in women. *Proc R Soc Med* 1953;**46**:558–64.
- Raz S, Smith RB. External sphincter spasticity syndrome in female patients. *J Urol* 1976;**115**:443–6.
- Fowler CJ, Kirby RS. Abnormal electromyographic activity (decelerating bursts and complex repetitive discharges) in the striated muscle of the urethral sphincter in 5 women with persisting urinary retention. *Br J Urol* 1985;**57**:69–70.
- Fowler CJ, Christmas TJ, Chapple CR, et al. Abnormal electromyographic activity of the urethral sphincter, voiding dysfunction, and polycystic ovaries: a new syndrome? *BMJ* 1988;**297**:1436–8.
- Fowler CJ, Kirby RS, Harrison MJ. Decelerating burst and complex repetitive discharges in the striated muscle of the urethral sphincter, associated with urinary retention in women. *J Neurol Neurosurg Psychiatry* 1985;**48**:1004–9.
- Butler WJ. Pseudomyotonia of the periurethral sphincter in women with urinary incontinence. *J Urol* 1979;**122**:838–40.
- Jensen D, Stien R. The importance of complex repetitive discharges in the striated female urethral sphincter and male bulbocavernosus muscle. *Scand J Urol Nephrol Suppl* 1996;**179**:69–73.
- FitzGerald MP, Blazek B, Brubaker L. Complex repetitive discharges during urethral sphincter EMG: clinical correlates. *Neurourol Urodyn* 2000;**19**:577–83.
- Fowler CJ, Dasgupta R. Electromyography in urinary retention and obstructed voiding in women. *Scand J Urol Nephrol Suppl* 2002;**55**–8.
- O'Connell HE, Hutson JM, Anderson CR, Plenter RJ. Anatomical relationship between urethra and clitoris. *J Urol* 1998;**159**:1892–7.
- O'Connell HE, DeLancey JO. Clitoral anatomy in nulliparous, healthy, premenopausal volunteers using unenhanced magnetic resonance imaging. *J Urol* 2005;**173**:2060–3.
- Swinn MJ, Wiseman O, Lowe E, Fowler CJ. The cause and natural history of isolated urinary retention in young women. *J Urol* 2002;**167**:151–6.
- Wiseman OJ, Swinn MJ, Brady CM, Fowler CJ. Maximum urethral closure pressure and sphincter volume in women with urinary retention. *J Urol* 2002;**167**:1348–51.
- Edwards L, Malvern J. The urethral pressure profile: theoretical considerations and clinical application. *Br J Urol* 1974;**46**:325–36.
- Wiseman OJ, Swinn MJ, Brady CM, Fowler CJ. Maximum urethral closure pressure and sphincter volume in women in retention. *J Urol* 2002;**167**:367–71.
- de Groat WC, Fraser MO, Yoshiyama M, et al. Neural control of the urethra. *Scand J Urol Nephrol Suppl* 2001;**35**:35–43.

30. Fowler CJ, Griffiths D, de Groat WC. The neural control of micturition. *Nat Rev Neurosci* 2008;**9**:453–66.
31. Kavia R, Dasgupta R, Critchley H, Fowler C, Griffiths D. A functional magnetic resonance imaging study of the effect of sacral neuromodulation on brain responses in women with Fowler's syndrome. *BJU Int* 2010;**105**:366–72.
32. Swinn MJ, Kitchen ND, Goodwin RJ, Fowler CJ. Sacral neuromodulation for women with Fowler's syndrome. *Eur Urol* 2000;**38**:439–43.
33. DasGupta R, Fowler CJ. Urodynamic study of women in urinary retention treated with sacral neuromodulation. *J Urol* 2004;**171**:1161–4.
34. Dasgupta R, Critchley HD, Dolan RJ, Fowler CJ. Changes in brain activity following sacral neuromodulation for urinary retention. *J Urol* 2005;**174**:2268–72.
35. Verhamme KM, Sturkenboom MC, Stricker BH, Bosch R. Drug-induced urinary retention: incidence, management and prevention. *Drug Saf* 2008;**31**:373–88.
36. Malinovsky JM, Le Normand L, Lepage JY, et al. The urodynamic effects of intravenous opioids and ketoprofen in humans. *Anesth Analg* 1998;**87**:456–61.
37. Kuipers PW, Kamphuis ET, van Venrooij GE, et al. Intrathecal opioids and lower urinary tract function: a urodynamic evaluation. *Anesthesiology* 2004;**100**:1497–503.
38. Petros JG, Realica R, Ahmad S, Rimm EB, Robillard RJ. Patient-controlled analgesia and prolonged ileus after uncomplicated colectomy. *Am J Surg* 1995;**170**:371–4.
39. Pandita RK, Pehrson R, Christoph T, Friderichs E, Andersson KE. Actions of tramadol on micturition in awake, freely moving rats. *Br J Pharmacol* 2003;**139**:741–8.
40. Pehrson R, Andersson KE. Tramadol inhibits rat detrusor overactivity caused by dopamine receptor stimulation. *J Urol* 2003;**170**:272–5.
41. Meyboom RH, Brodie-Meijer CC, Diemont WL, van Puijenbroek EP. Bladder dysfunction during the use of tramadol. *Pharmacoepidemiol Drug Saf* 1999;**8** (Suppl 1):S63–4.
42. Matsumoto S, Levendusky MC, Longhurst PA, Levin RM, Millington WR. Activation of mu opioid receptors in the ventrolateral periaqueductal gray inhibits reflex micturition in anesthetized rats. *Neurosci Lett* 2004;**363**:116–9.
43. Panicker J, Khan S, Kessler T, et al. The possible role of opiates in women with urinary retention. Observations from a prospective clinical study. 39th Annual Meeting of the International Continence Society (ICS). San Francisco; 2009.
44. Datta SN, Chaliha C, Singh A, et al. Sacral neurostimulation for urinary retention: 10-year experience from one UK centre. *BJU Int* 2008;**101**:192–6.
45. Van Voskuilen AC, Oerlemans DJ, Weil EH, van den Hombergh U, van Kerrebroeck PE. Medium-term experience of sacral neuromodulation by timed lead implantation. *BJU Int* 2007;**99**:107–10.
46. Elhilali MM, Khaled SM, Kashiwabara T, Elzayat E, Corcos J. Sacral neuromodulation: long-term experience of one center. *Urology* 2005;**65**:1114–7.
47. De Ridder D, Ost D, Bruyninckx F. The presence of Fowler's syndrome predicts successful long-term outcome of sacral nerve stimulation in women with urinary retention. *Eur Urol* 2007;**51**:229–33.
48. Elneil S, Khan S, Kavia RBC et al. Two-stage sacral neuromodulation for chronic urinary retention in women: outcome and response prognostic factors. In preparation.
49. Chen ML, Shen B, Wang J et al. Influence of naloxone on inhibitory predendal-to-bladder reflex in cats. *Exp Neurol* 2010;**224**:282–91.
50. Datta SN, Kavia RB, Gonzales G, Fowler CJ. Results of double-blind placebo-controlled crossover study of sildenafil citrate (Viagra) in women suffering from obstructed voiding or retention associated with the primary disorder of sphincter relaxation (Fowler's syndrome). *Eur Urol* 2007;**51**:489–97.
51. Fowler CJ, Betts CD, Christmas TJ, Swash M, Fowler CG. Botulinum toxin in the treatment of chronic urinary retention in women. *Br J Urol* 1992;**70**:387–9.
52. Jonas U, Fowler CJ, Chancellor MB, et al. Efficacy of sacral nerve stimulation for urinary retention: results 18 months after implantation. *J Urol* 2001;**165**:15–9.

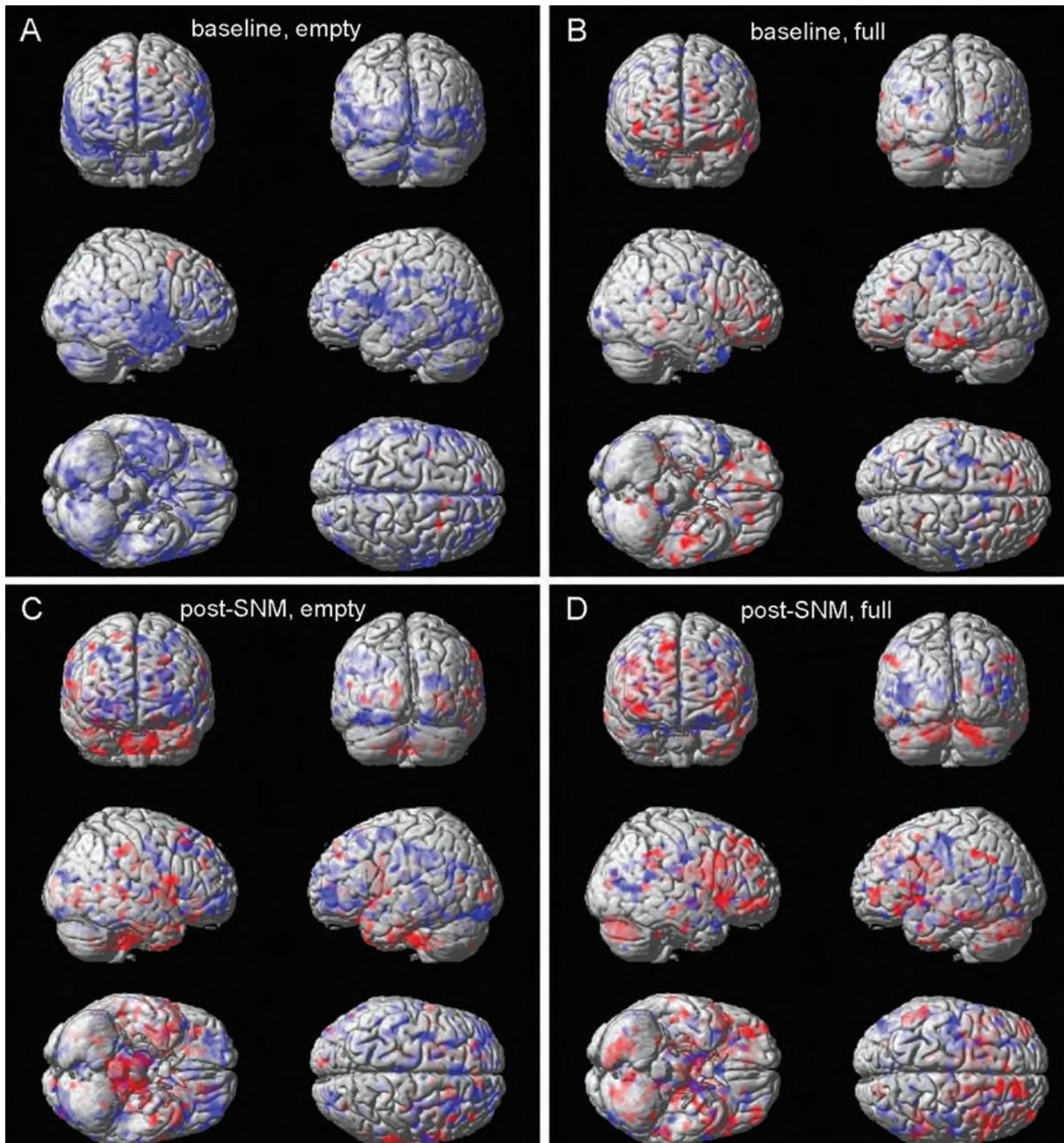


Fig. 19.4. Functional MRI study in Fowler's syndrome. Responses to bladder infusion for the six women, rendered (projected) on the brain surface. Red = activation; blue = negative response. A. Session at baseline with a near-empty bladder. B. at baseline with a full bladder. C. After SNM and a near-empty bladder. D. After SNM and a full bladder. Positive responses (red) indicate activation by bladder infusion. Negative responses (blue) indicate that the fMRI signal is smaller during infusion than during withdrawal. For the session at baseline with an empty bladder (Fig. 19.2A), the brain responses to bladder infusion (relative to withdrawal) were almost exclusively negative.

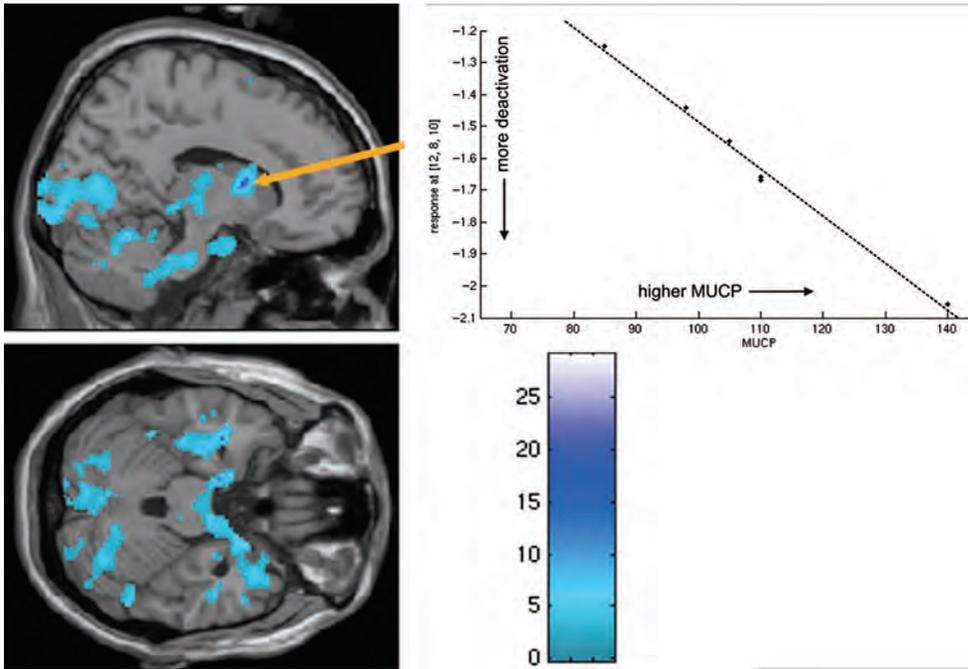


Fig. 19.5. Correlation between the defect in the interoception of filling, i.e. an abnormal negative response, and the maximum urethral closure pressure (MUCP), a proxy measure of the abnormality of sphincter activity, in the individual subjects.

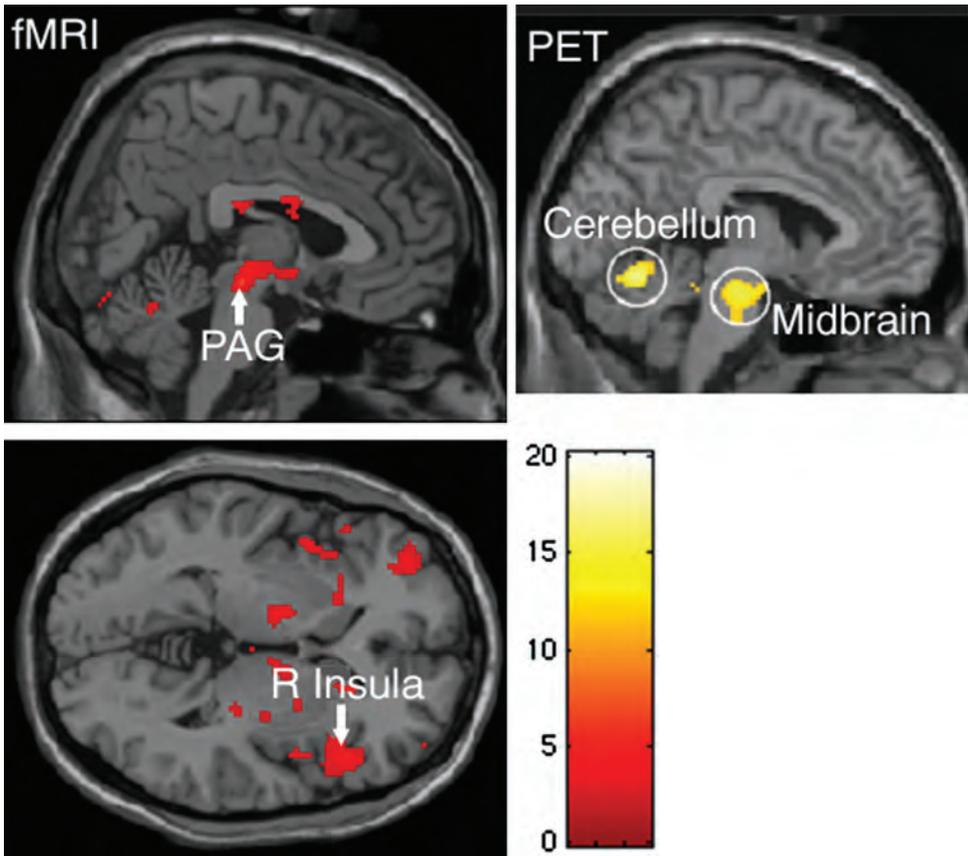


Fig. 19.7. PET imaging showed that with SNM afferent activity reached the midbrain [34] and more recently with functional magnetic resonance imaging (fMRI) [31] the PAG and right insula showed activation. Reproduced with permission.