

The pathogenesis of UTI in neuro-urolological patients is multifactorial. Male gender seems to be a risk factor for febrile and recurrent UTIs [407, 408]. Several etiological factors have been described: altered intrinsic defence mechanisms, impaired washout and catheterisation [409-412]. Poor glycemic control has also been established as a risk factor for UTI in women with type 1 diabetes [413]. However, the exact working mechanisms remain unknown. The presence of asymptomatic bacteriuria in SCI patients is higher than in the general population and varies depending on bladder management. Prevalence of bacteriuria in those performing clean IC varies from 23%-89% [414]. Sphincterotomy and condom catheter drainage has a 57% prevalence [415]. Asymptomatic bacteria should not be routinely screened for in this population [416] but a nomogram can be a helpful tool for early prediction of UTIs [417].

Individuals with neuro-urolological symptoms, especially those with SCI, may have other signs and symptoms in addition to or instead of traditional signs and symptoms of a UTI in able-bodied individuals [418]. Other problems, such as AD, may develop or worsen due to a UTI [244]. The most common signs and symptoms suspicious of a UTI in those with neuro-urolological disorders are fever, new onset or increase in incontinence, including leaking around an indwelling catheter, increased spasticity, malaise, lethargy or sense of unease, cloudy urine with increased urine odour, discomfort or pain over the kidney or bladder, dysuria, or AD [244, 419]. New incontinence is the most specific symptom, whereas cloudy and foul-smelling urine has the highest positive predictive value for UTI diagnosis [420].

3.5.2 **Diagnostic evaluation**

Urine culture and urinalysis are the optimum tests for the diagnosis of UTI in neuro-urolological patients. A dipstick test is more useful to exclude rather than to prove UTI [421, 422] and is not recommended. As bacterial strains and resistance patterns in persons with neuro-urolological disorders may differ from those of able-bodied patients, microbiologic testing is mandatory [423]. Neuro-urolological disorders may differ from those of able-bodied patients, microbiologic testing is mandatory [400].

3.5.3 **Disease management**

Bacteriuria in patients with neuro-urolological disorders should not be treated. Treatment of asymptomatic bacteriuria results in significantly more resistant bacterial strains without improving the outcome [424]. Urinary tract infections in persons with neuro-urolological disorders are by definition a complicated UTI; therefore, single-dose treatment is not advised. There is no consensus in the literature about the duration of treatment as it depends on the severity of the UTI and the involvement of the kidneys and the prostate. Generally, a five to seven day course of antibiotic treatment is advised, which can be extended up to fourteen days according to the extent of the infection [424]. The choice of antibiotic therapy should be based on the results of the microbiologic testing. If immediate treatment is mandatory (e.g., fever, septicaemia, intolerable clinical symptoms, extensive AD), the choice of treatment should be based on local and individual resistance profiles, as well as on results from previous urine cultures [425]. In patients with afebrile UTI, an initial non-antibiotic treatment may be justified [426, 427].

3.5.3.1 **Recurrent UTI**

Recurrent UTI in patients with neuro-urolological disorders may indicate suboptimal management of the underlying functional problem, e.g., high bladder pressure during storage and voiding, incomplete voiding or bladder stones. The improvement of bladder function, by treating NDO by botulinum toxin A injection in the detrusor [428], and the removal of bladder stones or other direct supporting factors, especially indwelling catheters, as early as possible, are mandatory [423].

3.5.3.2 **Prevention**

If the improvement of bladder function and removal of foreign bodies/stones is not successful, additional UTI prevention strategies should be utilised. In a meta-analysis the use of hydrophilic catheters was associated with a lower rate of UTI [244].

Various medical approaches have been tested for UTI prophylaxis in patients with neuro-urolological disorders. The benefit of cranberry juice or probiotics for the prevention of UTI could not be demonstrated in RCTs [429, 430]. Methenamine hippurate is not effective in individuals with neuro-urolological symptoms [431]. There is no sufficient evidence to support the use of L-methionine for urine acidification to prevent recurrent UTIs [432]. There is only weak evidence that oral immunotherapy reduces bacteriuria in patients with SCI [433] and that recurrent UTIs are reduced [434]. Low-dose, long-term, antibiotic prophylaxis can reduce UTI frequency, but increases bacterial resistance and is therefore not recommended [435].