DERLEME REVIEW

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Urethral Complications in Spinal Cord Injury

Spinal Kord Hasarlarında Üretral Komplikasyonlar

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ABSTRACT Spinal cord injury may pose a difficulty for the bladder to empty efficiently. In this scenario catheters are utilised, either in the form of clean intermittent catheterisation (CIC) or indwelling catheters. Little has been collated in the literature regarding the urethral complications associated with these methods of bladder drainage. We reviewed the literature of the published articles reporting on the urethral complications associated with catheter use in the spinal cord injured population. Long term, both methods carry a risk of urethral complications including tructuring, erosion, fistulation and diverticulum formation with less risk reported for CIC. Although reports of the management of these complications are limited in the literature, surgical repair forms the mainstay of management and in severe cases urinary diversion is required.

Keywords: Urethral complications; urethral erosion; urethral diverticulum; urethral stricture; urethral fistula; spinal cord injuries; clean intermittent catheterisation

ÖZET Spinal kord yaralanması, mesanenin etkin boşaltılmasında önemli güçlük çıkarabilir. Bu durumda "clean intermittent" kateterler (CIC) ve/veya "indwelling" kateterler kullanılabilir. Bu metotlarla mesanenin boşaltılmasına ilişkin üretral komplikasyonları ele alan literatürü gözden geçirdik. Spinal kord hasarı yaşamış popülasyonda kateter kullanımına ilişkin üretral komplikasyonları ele alan makaleleri derledik. Uzun dönemde, her iki kateter yönteminde de sık rastlanan komplikasyonlar erozyon, fistülasyon ve divertikulum formasyonu olmakla beraber, bu riskler CIC ile daha az rapor edilmiştir. Bu komplikasyonların yönetimine ilişkin makalelerin raporların sayısı az olmakla birlikte, bunların tedavisinde ana yöntem cerrahi onarım olmaktadır. Şiddetli olgularda üriner diversiyon gerekmektedir.

Anahtar Kelimeler: Üretral komplikasyonlar; üretral erozyon; üretral divertikulum; üretral yapışıklık; üretral fistül; spinal kord yaralanmaları; temiz aralıklı kateterizasyon

Urethral complications are recognised in patients post spinal cord injury (SCI) and can be challenging to manage. Our aim was to review the literature to identify the aetiology, incidence, risk factors and management for urethral complications in spinal cord injured patients.

METHODS

A search was carried out using the PubMed database for peer reviewed articles on 01/01/18. The following search terms were used: "spinal cord injury", "cauda equina", "neuropathic bladder" "neurogenic bladder" and were combined with "urethral complications", "urethral stricture", "urethral di-

verticulum", "urethral fistula", "urethral erosion", "urethral ulcer", "hypospadias" and "urethral trauma". After removal of duplicates 43 articles were included.

INCIDENCE

When assessing incidence, it was reported in 200 men with spinal cord injury (SCI) undergoing urethrography that 16 urethral diverticulae, five strictures and one false passage.[1] The diverticulae were said to occur at the penoscrotal junction most commonly followed by the membranous urethra and rarely at the fossa navicularis. This is not surprising as the penoscrotal junction is particularly susceptible in patients with an indwelling catheter that is left with tension. The limitation of this report is that it does not report why patients underwent urethrography.

Another paper reviewed video urodynamics and urethrography studies over twelve months reporting urethral diverticulae in 4.2 to 9.8% of patients. The presence of a urethral diverticulum was independently assessed by three spate physicians.[2]

A large study of 1418 video urodynamic studies in SCI men revealed a 25% prevalence of urethral strictures in men who performed CIC compared to 14% with other methods of bladder emptying.[3] The median time to stricture was reported at 5.9 years. Only one in three strictures had urethrotomy but the recurrence rate post-procedure was 100%. In general radiological studies suggest a risk of urethral trauma in SCI patients of around 20% depending on how patients were selected for the investigations and injury timing.

In 55 patients with SCI risk factors for urethral diverticula were assessed.[4] For diverticulae in the posterior urethra the length of time with SCI, detrusor sphincter dyssynergia, urethral catheter, external sheath drainage and sphincterotomy were correlated and for the anterior urethra CIC was implicated.

From a retrospective case series of 56 men with SCI whose continence was managed with a urethral catheter- five fistulae were seen, 12 erosions, 13 strictures and 5 periurethral abscess. Out of 86 non catheterised patients- 10 fistulae, six erosions and four strictures were found. Thus implicating the long term use of urethral catheter is associated with urethral erosions and strictures.[5] In another study of 123 patients, 12 developed urethral strictures at mean eight years follow up.[6] Two strictures occurred from five patients (40%) with an indwelling catheter and eight in 79 (10%) who did CIC. A case series of 400 patients managed with urethral catheters found only two urethral strictures and four urethral abscesses. However all four of these developed into urethral diverticulae.[7]

One study looked at a population of only female patients with indwelling urethral catheters, bypassing around the catheter was present in 92% of women.[8] The time between catheter insertion and leaking can be between six months and 30 years.[9] The incidence of urethral trauma with an indwelling urethral catheter is variable and will depend on the length of time with the catheter, frequency of change and how the patient looks after the catheter as it will intermittently pull against the bladder neck and penoscrotal junction. Urethral trauma may lead to stricturing or diverticulum formation.

Clean intermittent catheterisation (CIC) is an established method of bladder emptying in SCI with whom good hand function is preserved. One concerning risk of CIC is the creation of a false passage in the urethra, the rates of this are unreported in the literature. These can go undiagnosed due to lack of sensation in SCI patients and lead to late stricture or urethral diverticula. One series of known false urethral passage included 9 patients. Of these all were stented either after transurethral incision, fulguration or stenting alone. A urethral catheter was left in situ for 2-3 weeks post-operatively. Despite this two patients went on to develop stricture recurrence necessitating urinary diversion.[10]

Urethral stricture rate in patients who employ this CIC is reported to be less than 3.2% in some studies.[11,12] In the study by Asfar et al 164 patients performing CIC were followed up for a mean of 84 months, with only one patient developing a ureth-

ral stricture. Other reports of long term stricture rate in CIC have however been higher (10-20%). Attempts have been made to re-design catheters with the aim of reducing stricture rate. A long term (15 years) retrospective paper with 333 patients performing CIC had a stricture rate of 4.2%. All were treated with urethrotomy and recommenced on CIC without stricture recurrence recorded.[13]

A randomised controlled trial found no significant difference in stricture rate or haematuria with the use of a hydrophilic coated catheter Vs. a PVC but there was a high drop-out rate leading it hard to draw any substantive conclusions.[14] Another study of 30 patients using low friction hydrophilic catheters had four (13%) strictures noted at a median of seven years follow-up.[15] A prospective crossover study of 18 patients comparing a nelaton catheter Vs. a prelubricated non-hydrophilic catheter found lower urethral cell count on the surface of the non-hydrophilic catheter suggesting it causes less trauma.[16] A report of 14 patients who crossed over with a Lofric catheter and EasiCath had a dynamometer study which showed less friction with the former.[17] It seems logical that a low friction catheter would result in less urethral trauma. But patients technique and anatomy varies leading to a degree of trial and error to see which catheter type suits each patient to avoid complications. Another study of 24 patients compared PVC, hydrophilic and non-hydrophilic catheters (gel coated). The completion rate of the study was very low (only 10 patients) and follow up was only for 6 weeks. They concluded that patients had higher satisfaction rates with both the hydrophilic and gel coated catheters, but no variations of complicates rate were seen between the three.[18]

Developing countries often lack the resources to rely on single use CIC, so often rely on re-usable catheters. A study showed that re-usable silicone catheters did not lead to increased urethral complications in 23 men but did lead to increased UT.[19] The average catheter use of a single catheter was three years. Therefore, this could be a method of bladder management in developing countries.

A study of 61 elite athletes from 15 countries who all performed CIC was collected from the 2012 Paralympic games. They were all fit, with a mean age of 35 with the majority (75%) from developed nations catheterising on average 6 times a day (+/- 2). 83% of those from developed nations never re-used catheters, compared to just 27% in developing nations. Twice the numbers of UTI's were reported from developing nations athletes and in both populations who re-used catheters infections were statistically more likely.[20]

Radical ischiectomies are no longer widely performed as they carry a risk for exposing the perineal urethra to trauma and fistulation.[21,22] The majority of these patients required urinary diversion either with closure of the bladder neck and suprapubic or urostomy formation.

INVESTIGATION AND MANAGEMENT

The investigation of management of urethral complications has been described by a number of case series and reports but with no randomised trials in this area. The reports describe the surgical outcomes of managing urethral trauma for specific conditions such as diverticulae, erosions, fistulae and false passages or surgeons have reported combined outcomes of urethral surgery for all the types together to provide a larger dataset.

In the literature most urethral diverticulae were diagnosed by direct visualisation (cystoscopy). In diverticulae involving the posterior urethra, appreciation of the surrounding anatomy would also be considered useful and some form of cross sectional imaging would be advised for surgical planning. In a study of eight patients with diverticula ultrasound was used during intraurethral injection of saline and all diverticulae were defined morphologically on ultrasound.[23] Ultrasound is not a substitute for endoscopy or for CT/MRI but can be used if there is a contra-indication to CT/MRI which is non-invasive for the patient with a high diagnostic yield.

Monseur described the original surgical repair of urethral diverticulum in 1969.[24] Little has changed since and a case series of 48 patients where 90%

were bulbar and 10% penile reported no diverticular recurrences but strictures occurred in three patients and 10 patients with previous fistulae also recurred but half of these resolved with catheterisation for 4-5weeks.[25] Another case series of only four patients who underwent urethral diverticulae repair advocate one-stage repair with suprapubic diversion and reported no failures.[13]

False urethral passages due to catheterisation are high in the SCI population. It is easily diagnosed with cystoscopy. Management of the false passage should involve attempted initial catheterisation with a 14-16Fr catheter for 3-6 weeks. In one study this was performed for 3-6 weeks with 5 days of antibiotics in 6 patients, all false passages disappeared and there were no recurrences at mean 10 months follow-up.[26] A further study of eight patients with false passages had treatment with a 12f catheter placed under direct endoscopic control.[27] Some had stents placed due to patients refusal to have a catheter. This happened in five male patients who refused endoscopic placement of indwelling catheter for false passage due to inter- ference with sexual intercourse. Nitinol stents were inserted for 3 to 6 months allowing the false passages to heal.[28] If the false passage track has matured and fails to heal then an urethroplasty may be indicated.

Prolonged catheterisation can lead to urethral erosion. Commonly a hypospadias deformity in males and in women the urethra becomes patulous. Once damage is made to the female urethra careful assessment needs to be made as both the urethra and bladder neck are damaged in conjunction leading to the easy passage of two fingers directly into the bladder. In addition there may be no tissue between the finger and inferior pubic ramus leaving urinary diversion the only option. If there is sufficient urethral tissue then an autologous pubovaginal sling may be indicated.

A report of 14 women with a patulous urethra reported good success in all at six to 60 months follow-up with pubovaginal sling repair and all women were able to catheterise through the urethra.[29] If there is no room/tissue in which to support the urethra with a sling closure may be undertaken either abdominally, transvaginally or via a combined approach. Six women who underwent transvaginal closure were reported to be dry at six years follow-up.[30] Another report of 11 women who underwent urethral closure via a transvaginal approach reported on one failure at 6 weeks.[31] However, another series reported only 40% success from five transvaginal closures but 100% success from 10 combined abdominal and transvaginal closures.[32] Another stated that the retropubic approach to bladder neck closure in 26 patients had no complications when compared to the transvaginal approach, but only two underwent this method.[33] Similarly in another study, four patients who underwent transabdominal urethral closure were dry whereas four out of eight patients who underwent urethral closure transvaginally developed urethral fistulae.[9] Transvaginal closure is an attractive approach as it has reduced morbidity and is less invasive but it seems from the literature is has lower success rates. Currently there is insufficient evidence to say when to use either approach.

For catheter induced erosion causing hypospadias deformity urethroplasty is often undertaken. A report of in 11 men who had urethroplasty with a median length of stricture of 6cm reported a success of 64%.[34] All four recurrences occurred within the first month. In men with significant loss of urethral tissue transperineal closure of the membranous urethra ay be undertaken along with a form of urinary diversion. In one study of eight men and four women urethral closure was achieved in all men and three women.[35] Some patients however required multiple procedures to gain continent control.

Fistulae in the SCI population are difficult to manage. Cross sectional imaging such as MRI is vital in outlining the anatomy of the stricture.[36] Fistula may occur secondary to urethral obstruction, catheterisation, and infections from poor bladder management and pressure ulcers. All of which are common in the SCI population. It is vital this preceding causes are corrected before attempting surgical repair. By correcting the cause the fistula may

resolve without surgical intervention.[37] However the vast majority of cases require surgery at some stage. Urethral reconstruction is possible, but this is reduced to case reports with mixed outcomes most of which ultimately end in some form of urinary diversion. For an infected fistula abscess drainage and treatment of any osteomyelitis is necessary. In patients post sphincterectomy a urinary diversion ether continent or incontinent is a good option.[38]

In a report of 21 patents with urinary-cutaneous fistulae, seven due to decubitus ulcers, five wound infections, four condom catheter complications, four traumatic catheterisations and one pelvic trauma, 13 underwent fistula repair with seven eventually requiring an ileal conduit or suprapubic catheter.[39] In a similar report of urethral reconstruction performed in 17 patients (six urethral strictures, four erosions, three fistulae and one diverticula), of these 11 eventually required urinary diversion.[40] Only four patients had a patent urethra at 3.7 years follow up. In severe cases of decubitus pressure ulceration both faecal and urinary diversion may be required.[41]

Another small case series reported four patients with urethral stricture, fistula or diverticula who had urethral reconstruction successfully with an adapted Monseur technique.[42] A prospective database of 23 patients consisting of 10 erosions, seven strictures, three diverticula and two urethrocutaneous fistula and one combined diverticulum and stricture were treated surgically.[43] Successful reconstruction was possible in 60% of the erosions, 86% of the strictures, 67% of diverticula and fistulas. Patients with severe urethral erosion associated with deficiency or deterioration of the penile skin are likely not candidates for urethroplasty with penile or preputial skin flaps. Due to the high chance of repair breakdown urinary diversion should be considered early on.

CONCLUSIONS

Bladder management in the SCI cohort can be managed in a variety of ways depending on their level of injury/remaining function. CIC should be encouraged if possible due to the lower rates of urethral stricture and erosions Vs long term catheters. The type of CIC catheter used doesn't seem to matter as long as good technique and hygiene is adopted. Once severe complications such as fistula and diverticuale occur there is little out there in the literature. The preceding cause for this should always be corrected in the first instance before attempted surgical intervention.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Altaf Mangera;* ***Design:*** *Altaf Mangera;* ***Control/Supervision:*** *Altaf Mangera;* ***Data Collection and/or Processing:*** *Patrick Gordon, Altaf Mangera;* ***Analysis and/or Interpretation:*** *Patrick Gordon, Altaf Mangera;* ***Literature Review:*** *Patrick Gordon, Altaf Mangera;* ***Writing the Article:*** *Patrick Gordon, Altaf Mangera;* ***Critical Review:*** *Altaf Mangera;* ***References and Fundings:*** *Patrick Gordon, Altaf Mangera.*

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