

Urethral Stenting in a Cat with Refractory Obstructive Feline Lower Urinary Tract Disease

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ABSTRACT. A 10-year-old male Korean domestic short-haired cat was presented with refractory lower urinary tract obstruction. The cat was treated by urethral stent placement using a self-expanding nitinol intraluminal stent (Zilver® 535 biliary stents, COOK®, U.S.A.) subsequent with balloon expansion. Although the cat showed 2 days of transient hematuria after the stent placement, no further obstruction was occurred after the stent placement. Follow-up studies performed at monthly intervals have found no re-stenosis or particular complications, to date.

KEY WORDS: feline, FLUTD, FUS, urethral obstruction, urethral stent.

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Lower urinary tract disease (LUTD) in cats has numerous causes including infection, trauma, urolithiasis, urethral obstruction or neoplasia [1]. Unlike dogs however, the most frequent cause for haematuria and dysuria in cats is unknown. This has led to numerous terms such as feline urologic syndrome (FUS), feline interstitial cystitis (FIC; based on similarities with the human condition) and idiopathic feline lower urinary tract disease (iFLUTD) [8, 16]. It is reported that 70% of non-obstructive LUTD is idiopathic and that 25% is due to cystoliths [6]. Obstructive causes of LUTD are usually intraluminal with the majority caused by urethral plugs rather than uroliths. Urethral plugs have large amounts of matrix and minerals (usually struvite) and any crystalline material is disorganized. The general features of urolithiasis are similar for cats and dogs although struvite uroliths in cats are less associated with bacterial infections [6, 7].

Although the successful treatment of iFLUTD is often achieved with the removal of dry diets, stress reduction and increased water supply after re-canalization with indwelling urethral catheterization and warm saline flushing [5, 7]. However, iFLUTD often re-occurs and progresses to refractory iFLUTD, which requires perineal urethrostomy to permanently relieve recurrent obstructions in male cats [5, 7]. However, there can be post-operative problems such as stricture, recurrent urinary tract infections and perineal hernias [8, 16].

Urethral stent placement using self-expanding metallic stents under fluoroscopic guidance is widely used in humans and dogs with urethral obstructions secondary to transitional and prostatic tumors [9, 12–14]. This technique has several advantages over conventional surgical methods, because it can be used to rapidly, safely, and effectively relieve ure-

thral obstructions, especially in patients in which other traditional techniques have failed, are not available, or not indicated [18]. These techniques are minimally invasive and can therefore lead to reduced peri-operative morbidity and mortality, shorter anesthesia times and shorter hospital stays, although the expense for urethral stent placement is substantial. This case report described the clinical application of urethral stent in a cat with refractory urethral obstruction.

A 10-year-old male Korean domestic short-haired cat (3.9 kg of body weight) was presented at the Veterinary Teaching Hospital, Kangwon National University with clinical signs of anuria, anorexia and lethargy. According to the referring veterinarian, the cat suffered recurrent lower urinary obstruction for the past 3 years. Abdominal palpation showed distended bladder. No remarkable abnormalities were observed in routine hematology and chemistry. Abdominal radiography showed distended and thickened urinary bladder, confirmed by double contrast cystogram. Ultrasonography found markedly thickened bladder wall (Fig. 1A). Urinalysis (LabStrip U11Plus®, Analyticon Biotechnologies, Germany) revealed 3+ proteinuria, 2+ hematuria, increased urine specific gravity (1.050) and urine pH (7.2). Urine sediment test showed 20 white blood cells/high power field (hpf), 10 red blood cells/hpf and struvite crystals. Urine culture and antibiotics sensitivity tests were submitted. The lower urinary obstruction was treated by passing urethral catheter (1-inch, 24-gauge intravenous catheter, BD, U.S.A.) and reverse flushing with warm 0.9% saline. After dislodging urinary plugs, the bladder and urethra were lavaged to remove residual plugs and cell debris. The cat was released with prescription of ammonium chloride (100 mg/kg, PO, BID), amoxicillin (15 mg/kg, PO, BID) and amitriptyline (10 mg/kg, PO, BID) and recommendation of dietary modification (change to wet diets) and increasing water supply.

A week later the cat was presented again with urinary

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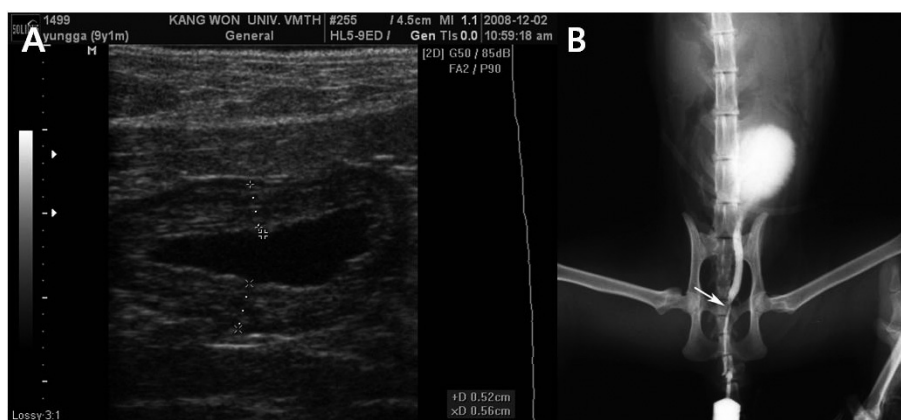


Fig. 1. Diagnostic imaging studies of this case. A: Ultrasonography of this cat showing remarkably thickened bladder wall. B: Urethrography of this cat showing stenotic urethra (arrow) and post-stenotic dilation at proximal urethra.

obstruction. At that time we obtained the result of bacterial culture. Urine culture studies found gram negative rod bacteria (*Enterobacter* species $>100,000$ CFU/mL) and amikacin was the only sensitive anti-bacterial agent. The obstruction was relieved with urethral catheterization and warm saline lavage. The cat was released again with the same prescription except changing the antibiotic agent to amikacin (15 mg/kg IM, SID). A month later the cat was obstructed again, although the urine culture performed at 3 weeks after amikacin treatment found no bacteria. Urethrogram was performed and revealed almost stenotic urethra at the middle of urethra and post-stenotic dilation at the proximal urethra (Fig. 1B). Since the urethral obstruction was recurrent and refractory, urethral stent placement with self-expandable intraluminal nitinol stent was performed.

For the placement of urethral stent, the cat was placed under general anesthesia and positioned in lateral recumbency with guidance of fluoroscopy. Urethral catheter (1-inch, 24-gauge intravenous catheter, BD Medical, U.S.A.) was inserted into urethral orifice and small volume of iohexol (Omnipaque®, GE healthcare, Korea) was then infused to visualize the obstructed region of urethra. After measuring the obstructed region of urethra, 5 mm (diameter) \times 30 mm (length) of self expanding intraluminal nitinol stent (Zilver® 535 biliary stents, COOK®, U.S.A.) was selected. To perform urethral stenting in this cat, urethral catheterization was performed via percutaneous antegrade urethral access (PAUA). The 0.035" angled, floppy-tip hydrophilic guidewire (Fixed Core Wire Guides Safe-T-J® Curved, COOK®, U.S.A.) was inserted into the bladder trigone over the 18 gauge needle catheter from the abdominal skin with ultrasonographic guidance. The wire was advanced antegrade into the urethra and out the penis, resulting in "through-and-through" access. A 7 French vascular sheath and dilator (Check-Flo Performer® Introducer, COOK®, U.S.A.) was advanced retrograde over-the-wire and into the urinary bladder. The dilator was then removed. The balloon dilation catheter (ATB® ADVANCE® PTA

Dilatation Catheter, COOK®, U.S.A.) was then inserted into the preplaced vascular sheath and located at the obstructed (stenotic) region of urethra. The balloon was then inflated and deflated 3 times to expand the obstructed region with inflation device (Sphere™ Inflation device, COOK®, U.S.A.). Afterwards the balloon dilation catheter was removed. A 5 mm (diameter) \times 30 mm (length) self expanding intraluminal nitinol stent (Zilver® 535 biliary stents, COOK®, U.S.A.) was then inserted through the preplaced vascular sheath, located and released at the obstructed region (Fig. 2A & B). After placing the intraluminal stent, the balloon catheter was re-inserted inside the stent and then the balloon was re-inflated to achieve the maximal expansion of the stent at the obstructed region (Fig. 2C & D). After successful placement of urethral stent, an indwelling catheter was installed from the urethral orifice and left till the hematuria was gone.

A week later, radiography was taken and found no further obstruction or stent migration and deformation (Fig. 2E & F). The cat was released prescribed with ammonium chloride (100 mg/kg, PO, BID) and recommendation of wet diet and increased water supply. The cat is currently monitored at monthly intervals and maintains normal urinary flow (almost 7 months after the stent placement, to date).

Both balloon-expandable (BEMSs) and self-expanding metallic stents (SEMSs) are generally used for relieving urinary obstruction in dogs [2, 3, 7, 10, 11, 18, 19]. The major advantage of BEMSs is lack of the foreshortening that occurs with some types of SEMSs, although BEMSs relatively lack flexibility and elasticity. SEMSs are laser-cut, nickel-titanium alloy (nitinol) stents and are more flexible and have moderate expansile strength and radial force. In this study we used the SEMS type with balloon expansion to overcome the limitation of BEMS. One recent study found that SEMSs placed in the urethra of 18 healthy German Shepherds caused no superficial corrosion, infections, dislocations, encrustations, stone formations, or foreign body reactions for 18 months, although progressive pseudopoly-

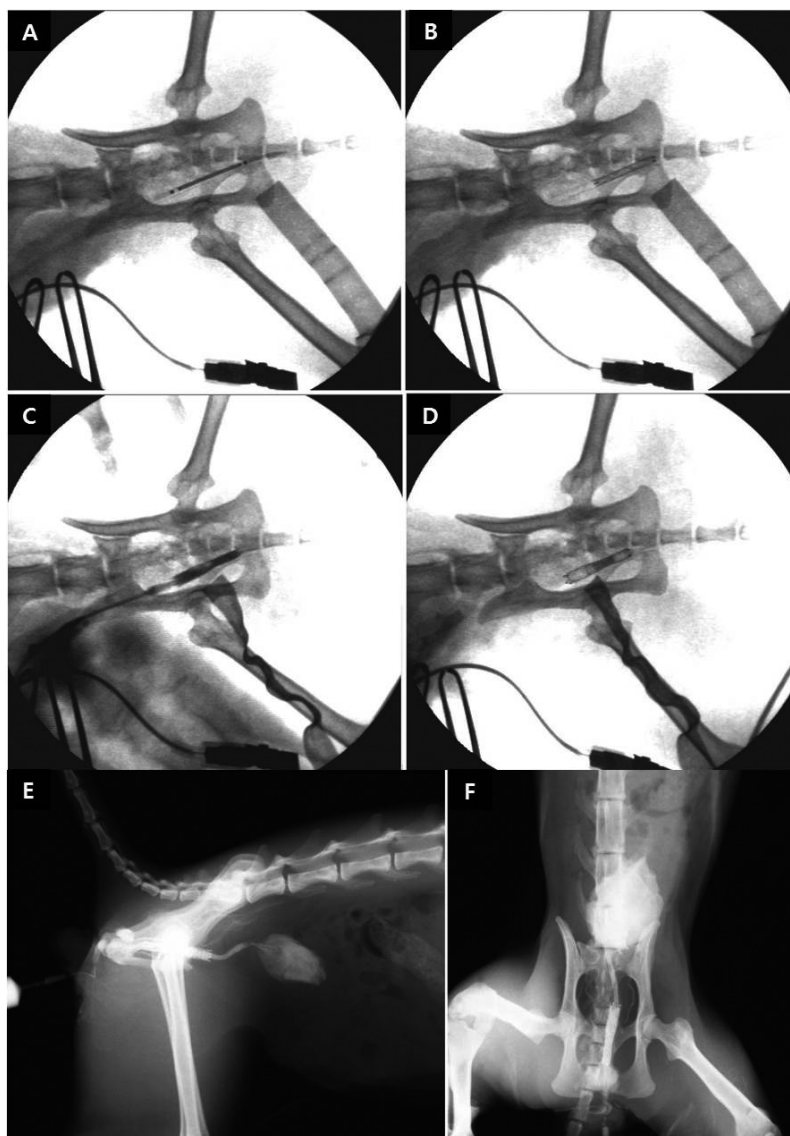


Fig. 2. Procedure and clinical outcome of urethral stenting in this cat. A&B. 5 mm (diameter) \times 30 mm (length) of self expanding intraluminal nitinol stent (Zilver[®] 635 biliary stents, COOK[®], U.S.A.) were inserted through the preplaced vascular sheath, located and released at the obstructed region. C&D. After placing the intraluminal stent, the balloon catheter was re-inserted inside the stent and then the balloon was re-inflated to achieve the maximal expansion of the stent at the obstructed region. E&F. Urethro-gram (E: lateral and F: ventrodorsal projection) taken 3 months after the stent placement revealed no further obstruction or stent migration and deformation.

pous mucosal hyperplasia developed over the stent surface in histopathological examinations [11, 18]. Another study using polyurethane covered wire stents with paclitaxel-eluting coatings found much favorable clinical outcome in dogs [11, 17].

Main complications associated with urethral stent placement in dogs are luminal re-stenosis by epithelia hyperplasia resulting from stent placement, re-obstruction resulting from either a blood clot or mucosal swelling and edema sec-

ondary to excessive balloon dilatation and presumptive urethral mucosa trauma or tearing and development of urinary incontinence resulting from the damage to urethral sphincter by stent placement [2, 3, 7, 10, 11, 18, 19]. Unfortunately, no concrete study related to urethral stent placement in cats has been conducted yet. However, we expected similar complications found in humans and dogs to occur in cats associated with urethral stent placement.

Due to the lack of feline study for urethral stent place-

ment, we initially agonized over the choice of type of intraluminal stent (e.g. type, length, and diameter) in this case. One canine study used the stent approximately 10% greater than the maximum luminal diameter to ensure adequate mucosal apposition, minimize the chance of migration, and reduce trauma to the urethral wall. Another canine study suggested that the unconstrained stent diameter should not exceed 1.3 times the diameter of the prostatic portion of the urethra [4, 11, 16, 17]. Also one canine study suggested the stent length to be chosen with the objective of reestablishing urethral patency while minimizing stenting of the adjacent healthy urethra [17]. In this study, we chose a 5 mm (diameter) and 30 mm (length) stent, based on the maximal diameter of proximal urethra (4.5 mm). However, we expanded the internal diameter of the stent to 6 mm using a balloon expansion catheter to ensure adequate mucosal apposition and to minimize the chance of migration of the stent. In addition, we placed a 30 mm length-stent to cover approximately 10 mm away from each end of the obstructed urethra (~10 mm), to prevent further obstruction due to the progressive nature of feline obstructive lower urinary tract disease. We also flushed the bladder with heparin diluted in saline (10 U/mL) for 3 days to prevent the obstruction by blood clot and proteinaceous and cellular debris. Although we suspected twisting or fracture of the stent to be the problem in a curvy structure like the urethra, the stent maintained its original conformation. Progressive shortening in its original diameter and length was a major technical problem in the SEMSs used to treat tracheal collapse in dogs [18]. However this problem was not noticed in this case, to date (7-month post-evaluation). Urinary incontinence after urethral stent placement was a major clinical complication in dogs and a cat with urethral stent placement [1, 15, 18]. One canine study found the placement of urethral stents in 8 male dogs with prostatic neoplasia caused temporary severe incontinence (for 3 to 7 days) in 2 dogs and permanent severe incontinence in 1 dog [18]. One recent study treated a cat with a mass in the region of the bladder neck using a BEMS, to relieve malignant urethral obstruction [15]. The clinical outcome was favorable, although the cat had signs of urinary incontinence and detrusor atony, initially. Unfortunately, the cat was euthanized 1 month after stent placement because of underlying disease. However, in our study, the stent did not cause urinary incontinence, probably because it did not affect the function of urethral sphincters and because it was not affected by the infiltrative nature of urogenital tumors. Also clinical outcome was more favorable, since any complications related to stent placement have not been noticed, to date, although this cat showed transient mild hematuria for 2 days after the placement. We believed better clinical outcome in our study might be achieved, because our case was a less malignant disease (i.e. malignant carcinoma vs iFLUTD) and the stent was placed at the region where minimally affecting the function of urethral sphincters. Due to the lack of feline studies using metallic stents, it is hard to conclude the SEMS has advantage over BEMS in treating feline malig-

nant obstruction. Authors believed the location of stent placement (where minimally affecting urethral sphincters) and proper selection of stent diameter (to ensure adequate mucosal apposition and to minimize the chance of stent migration) might be a more important factor for success of treatment.

In conclusion, this is the first clinical case study treating a cat with refractory iFLUTD using a SEMS with balloon expansion via transcutaneous approach. We found that this new therapeutic modality was minimally-invasive and highly effective for maintaining urethral patency in a cat with refractory iFLUTD. The follow-up study found very little discomfort and no serious complications associated with urethral stent placement.

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