*Brief Communication*

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# The Use of Radial Extracorporeal Shockwave Therapy in the Treatment of Urethral Urolithiasis in the Horse: A Preliminary Study

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**Background:** Radial extracorporeal shockwave therapy (ESWT) is widely used in equine practice for the treatment of orthopedic problems. However, its original use as a lithotripsy device in human and canine urology led us to postulate that it could be used as an alternative to the surgical treatment of urethral calculi in horses.

**Hypothesis:** Radial ESWT can easily and safely fragment calculi in the distal urethra of the horse.

**Animals:** Two postmortem cases and 1 live case of obstructive urinary disease admitted at the Veterinary Teaching Hospital of Liege.

**Methods:** A radial shockwave device was directly applied to the urethra in an attempt to fragment calculi. An ex vivo trial was performed on the same retrieved calculi to investigate pressure settings in order to obtain complete fragmentation of the calculus.

**Results:** In all cases, radial ESWT was able to fragment the calculus partially, enabling retrieval of the remaining fragments via the urethra. Much higher pressure settings than those used for in vivo partial fragmentation were necessary to obtain complete destruction of the calculi ex vivo.

**Conclusions and Clinical Importance:** This brief report suggests the use of radial ESWT as a safe and useful alternative to more invasive surgical management of urethral calculi in horses.

**Key words:** Calculi; Horse; Penis; Shock wave; Urolithiasis.

In equine medicine, extracorporeal shockwave therapy (ESWT) currently is commonly applied in the treatment of orthopedic problems and has become widely available in many equine practices. However, it has been used for a much longer period in humans for lithotripsy, for which it was initially developed.[1] Apart from more standard and invasive surgical removal of calculi, only pulsed-dye laser,[2] holmium : YAG laser,[3] and ballistic shockwave[4] lithotripsy have been published as methods for disruption of cystic calculi in horses. In canine medicine, nephroliths or ureteroliths have been successfully fragmented by ESWT.[5] To the authors knowledge, there are no reports on the use of ESWT in the treatment of calculi in horses. Our experience with 3 cases presented at the Equine Clinic of the Veterinary Teaching Hospital of the University of Liege, Belgium shows that ESWT could be an alternative method to more invasive surgical procedures to treat urethral calculi in horses.

Obstructive urinary disease in horses is rare[6] and is mainly caused by urolithiasis. There seems to be predilection for localization in the bladder (60% of urolithiasis cases), although urethral (24%), ureteral (4%), and renal calculi (12%) also occur.[6] Review articles have shown urolithiasis to be more common in male horses (75% of cases), especially geldings.[6] It is thought that mares are equally affected, but because of the large diameter of their urethra, the calculi probably are self-resolving. Clinical signs depend on the site and degree of obstruction. Affected horses are commonly presented with moderate to severe signs of abdominal pain, frequently posture to urinate, and have a history of stranguria or dysuria. The diagnosis is usually straightforward, especially when the obstruction is located distally. Unless bladder rupture has occurred, rectal examination usually reveals a distended bladder in horses with complete obstruction. Most of the urethroliths initially lodge over the ischial arch where the urethra is narrowest,[6] and then gradually pass farther down until they fully obstruct the passage. They can be palpated as a firm mass at the level of the perineum or in the penis itself. Urethral catheterization and ultimately urethroscopy confirm the diagnosis. Urethral obstruction in the horse is a serious condition, which generally does not permit conservative management.[7] Most commonly, a perineal urethrotomy or direct incision over the calculus, known as distal urethrotomy, is used for direct retrieval of the calculus.[6–8] Urine fistulization and stricture of the urethra are reported as complications of these surgical procedures.[7,8] First intention healing by correct reconstruction of the anatomical structures is of paramount importance when performing distal urethrotomy to avoid urine leakage and development of cellulites.[8]

The aim of this study was to report the use of radial ESWT as a safe alternative and less invasive treatment for urethral calculi in male horses.

## Materials and Methods

Between June 2006 and March 2007, 3 horses with a diagnosis of urethral obstruction were presented at the Veterinary Teaching Hospital of Liege. The first 2 horses, a 12-year-old Shetland pony (case # 1) and a 10-year-old donkey (case # 2) were referred to the

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clinic for colic and a history of dysuria. On admission, they both had signs of lethargy and anorexia, suggestive of acute postrenal failure. This diagnosis was then confirmed by ultrasonography, which revealed free hypoechoic abdominal fluid in both animals. In case # 1, the peritoneal creatinine concentration (26 mg/dL) was increased 2-fold as compared with the serum creatinine concentration (13 mg/dL). Serum chemistry evaluation showed hyperkalemia (5.5 mEq/L), slight hyponatremia (128 mEq/L), and slight hypochloremia (93 mEq/L). In case # 1, the site of the obstruction could be clearly identified at the level of the ischial arch. In the donkey (case # 2), the calculus was located in the distal part of the penis. Because of financial limitations and guarded prognoses, both owners elected euthanasia without attempting treatment. After euthanasia, radial ESWT[a] was used in an attempt to fragment the calculi. In both cases, the device, with the large-headed probe, was held directly on the calculus and an application of 2,500 pulses set at 2.5 bar and 7 Hz was able to fragment the calculus. Urethral passage was then tested by retrograde flushing via the urethra. No resistance was noted, proving that fragmentation of the calculus had resolved the obstruction. Postmortem examination identified intra-abdominal rupture of the bladder in both animals. In the Shetland pony (case # 1), a 1-cm-long tear was located in the dorsal mid-part of the bladder, whereas the tear was located in the ventral mid-part of the bladder in case # 2. In both, the bladder mucosa was irritated and had chronic ulcerative lesions in several locations. In the donkey (case # 2), a more chronic process was suspected because fibrous adhesions were found between the ventral bladder serosa and the abdominal wall. In both cases, fragmented uroliths were found in the bladder and in case # 2 also in the abdomen.

A 3rd case, a 6-year-old Belgian Draft Horse gelding was referred to the hospital for further examination after showing moderate signs of colic. The horse had difficulty working and the owner had not seen it urinate during the day. On admission, the horse had tachycardia and tachypnea. Borborygmi were diminished in all quadrants on abdominal auscultation. Blood analysis showed a slightly high PCV. Rectal examination revealed a large distended bladder and catheterization of the urethra was not possible. A firm mass of approximately 6 cm was palpated in the distal portion of the penis. A perineal urethrotomy under local anesthesia was performed in the standing horse to relieve intravesical pressure before fragmentation of the calculus with a radial ESWT device. The penis was firmly grasped at the site of the calculus and the ESWT device was directly applied on the penile shaft without use of any contact gel (Fig 1). While applying the shock waves (pressure setting at 2.5 bar, 7 Hz), sand-like content progressively dropped from the penis a few seconds after application and the calculus fragmented. Finally, after partial fragmentation, which took about 5 minutes and approximately 2,500 pulses, the calculus was fully retrieved after it naturally dropped from the urethral opening. The recovery of the horse was uneventful and urethral endoscopy performed after the procedure did not identify any clinically relevant damage to the urethra.


**Fig 1.** Radial extracorporeal shockwave therapy (ESWT) (EMS Dolorcast, lower left) application directly on the penis on the image in the upper left corner. The image on the upper right shows case # 2 on its back with radial ESWT applied in the perineal region.

Calculi from cases # 2 and # 3 were sent for examination and were found to be composed mainly of calcium carbonate. Destruction of the residual calculi obtained from case # 1 also was performed ex vivo by the application of ESWT on the calculus wrapped in a cloth. Shock waves were applied at different pressures and full destruction of the core of the calculus was finally obtained with the pressure set at 3.5 bar. Partial fragmentation, not involving the core of the calculus, occurred at 2.5 bar.

## Discussion

All animals in this report had the classical presentation of urethral urolithiasis as described in male horses. The composition of the retrieved calculi conformed to the description of calculi retrieved in other studies[6,9] (ie, calcium carbonate). These results confirm the nature of the stones and the possibility for radial ESWT to fragment the most common calculi found in horses.

Although commonly described as a successful therapeutic option,[5] ESWT lithotripsy is not widely practiced in small animals. Because of the different composition of the stones (approximately 50% are struvite[10]), alternatives may be used or contraindications may occur. Firstly, med-

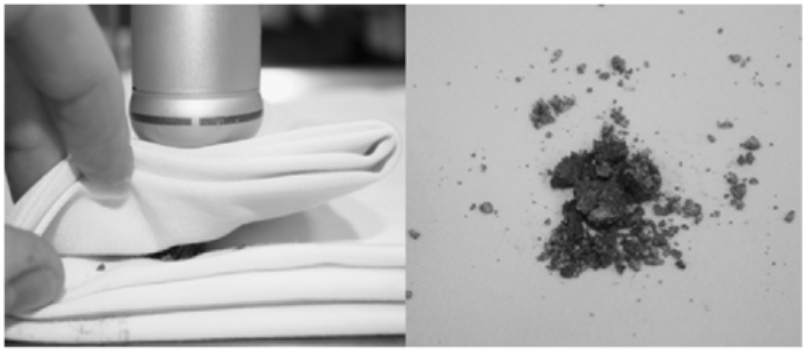

**Fig 2.** Ex vivo trial showing calculus wrapped in a cloth (left) and fragmentized calculus (right).

ical management can often easily and successfully be performed after retrograde urohydropropulsion is applied to dislodge struvite urethral calculi to the bladder in dogs.[10] Secondly, cystine calculi in general[11] and calcium oxalate calculi in cats[10] are poor candidates for lithotripsy, because they are very resistant to fragmentation. Deleterious effects of ESWT have been described in small animals where clinically relevant postoperative renal deterioration can occur when percutaneous nephrolithotripsy is performed.[10,11] Moreover, because of their small size, cats are more likely to be subjected to shock wave–induced tissue injuries.[5,11] Nevertheless, ESWT is described as a nonsurgical treatment of Peyronie's diseases in humans. This disorder of the penis is characterized by dense, fibrous plaque formation in the tunica albuginea sometimes associated with calcification or ossification and clinically causing pain, distortion, and erection problems.[12] Despite the lack of conclusive evidence of effects of ESWT[13] in the treatment of Peyronie's disease, it was shown to have minimal adverse effects and to be safe. Thus, this approach also should be safe to apply directly on a horse's penis. However, one should be aware of the specific physical settings of ESWT. Shock waves move in liquid medium and soft tissues until they reflect on tissues with different impedance, resulting in the liberation of kinetic energy at the interface of the tissues. Therefore, shock waves cannot be focalized on cavities filled with gas. The much lower impedance of air compared with soft tissues will reflect the acoustical energy resulting in a dramatic increase in the positive pressure of the shock wave, possibly resulting in tissue damage. The direct use of ESWT on a calculus creating a complete obstruction with clinically relevant distension of the bladder may therefore be dangerous. For this reason, in case # 3, it was decided to perform a standing urethrotomy in the perineal region to decompress the bladder first. Nevertheless, incising the urethra over the penile shaft and all the complications associated with it was avoided using ESWT.

Sedation is commonly used when applying ESWT for orthopedic problems because of the discomfort and possible pain caused by treatment. However, because of the diuretic effect of $\alpha_2$ agonists, caution is warranted when sedating a horse with urinary obstruction and a severely distended bladder. Nevertheless, in case of obstructive urinary disease, decreased renal blood flow, glomerular filtration rate, and urine output occur[14] such that the use of these drugs could be considered safe for a procedure of so short a period of time.

From our ex vivo trials (Fig 2), complete destruction of the calculi was obtained only at pressures set at 3.5 bar, but partial destruction was already obtained in vivo and ex vivo at 2.5 bar. Although ESWT was safely applied to the penis in the treatment of Peyronie's disease and considering that full destruction of the calculus is normally not necessary to obtain resolution of the obstruction, it is reasonable not to use excessive pressure settings so as to avoid damage to surrounding tissues (Fig 2).

From this preliminary report on the use of radial ESWT in the treatment of urethral obstruction in the male horse, we can conclude that radial ESWT is a safe alternative method to fragment calculi. The establishment of more precise pressure settings should be considered in order to avoid possible damage to the penile tissues if the pressure is set too high.

## Footnotes

[a] EMS Dolorcast, Nyon, Switzerland

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