

Case report-hypothesis: a congenitally lax pubourethral ligament may be a contributing cause of vesico-ureteric reflux

ALFONS GUNNEMANN,¹ SHU FON MUNA,¹ PETER PETROS²

¹Dept of Urology, Klinikum Lippe Detmold Germany

²University of Western Australia, Perth Western Australia

Abstract: Background: The hypothesis derives from the field of female stress incontinence. Application of pressure on the anterior vaginal wall at midurethra with a hemostat restores the geometry of the vesicourethral junction and continence. **Methods:** We applied unilateral midurethral pressure during a radiological investigation of a 15 year old patient who had undergone 2 surgeries for ureteric reflux. **Results:** On injection of the dye into the bladder, reflux was noted in the left ureter, and this disappeared within 2-3 seconds after pressure was applied on 2 successive occasions in the midurethral area of the vagina. **Conclusion:** The hypothesis that a musculoelastic mechanism dependent on a competent pubourethral ligament may play a role in vesicoureteral valvular closure, appears to have been confirmed, at least in one case. Hopefully this observation will lead to further studies, and perhaps, new directions for therapy.

Key words: Vesicoureteric reflux; Musculo-elastic closure; Ureterovesical junction; Pubourethral ligament; Integral Theory.

INTRODUCTION

There have been no new hypotheses for causation of vesico-ureteric reflux for many years. The aim of this report is to present a new hypothesis, deriving from the field of female stress incontinence. In females with stress urinary incontinence, application of pressure on the anterior vaginal wall at midurethra with a hemostat restores the funnelled geometry of the vesicourethral junction to normal, and continence.¹ The mechanism for this is based on a competent pubourethral ligament acting as a firm anchoring point for the three directional muscle forces which activate distal and proximal urethral closure (figure 1). Based on a report on improvement of vesico-ureteric reflux in an adult female following a midurethral sling,² it was hypothesized that a similar mechanism may act to prevent vesico-ureteric reflux (Figure 1). The ureters traverse the bladder wall to the trigone; the muscle forces (arrows) stretch the trigone backwards and downwards around a competent pubourethral ligament (PUL) to close off the proximal urethra, and ureterovesical junction.

We report on a serendipitous testing of this hypothesis.

CASE REPORT

A 15 year old young woman presented with a long history of vesicoureteric reflux and chronic cystitis, treated with prophylactic antibiotic therapy. Symptoms during remission included, urgency abnormal bladder emptying, with residual urine volumes of up to 60 ml. A duplex system on the right side was corrected with an extravesical cystoneostomy (Gregoir-Lich). Because of continuing reflux, she had a 2nd operation of the right ureter duplex (Politano-Leadbetter).

The immediate reason for this admission was to exclude an upper renal calyceal bacterial focus for a pyrexia not apparently due to bladder infection. Renal ultrasound indicated dilated right upper calyces, but no evidence of obstruction. Renal scintillography showed apparently decreased function in that area.

The management plan was to insert a ureteric catheter into the upper right renal calyx, and to take a sample of urine for bacterial culture and sensitivity. Radioopaque dye (250 ml) was injected into the bladder to guide the catheter. The test was applied as described previously.¹

RESULTS

There was no reflux observed into the right double system, but ureteric reflux was seen on the left side (figure 2). On cystoscopy, the urethra was normal, with no mechanical obstruction evident at the meatus, or anywhere along its length. Large complex trabeculae were seen in the bladder wall. The left orifice was "horseshoe" in shape, according to the classification of Lyon,³ and laterally displaced. When the forceps was unilaterally applied retropubically at midurethra, (figure 1), within 2-3 seconds the reflux had disappeared, as documented fluoroscopically, (figures 2-3). This was repeated on a 2nd occasion with the same results.

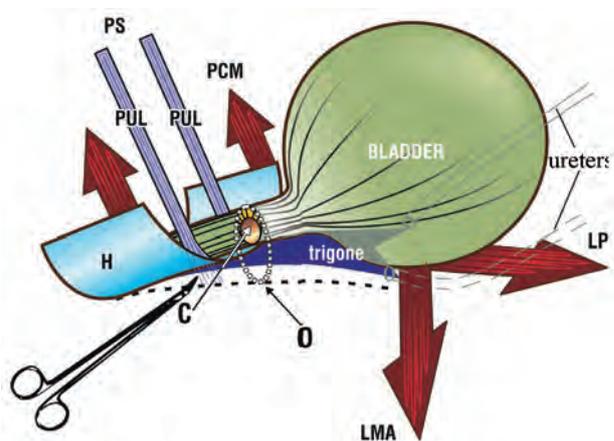


Figure 1. – A hypothesis for an adjunctive role of pelvic muscle forces in ureterovesical closure.

The 3 directional muscle forces (arrows), PCM (m. pubococcygeus), LP (levator plate) and LMA (longitudinal muscle of the anus), stretch the hammock (H) forwards, and the trigone backwards/downwards to activate distal and proximal urethral closure.¹ It is hypothesized that this same action stretches the trigone and bladder base to assist closure of the ureterovesical junction. Pubourethral ligament (PUL) laxity inactivates these muscle forces, diminishing the backward stretching of the trigone, loosening the connective tissue/muscular junction sufficiently to cause vesicoureteric reflux. The forceps indicates point of upward pressure applied during the procedure, immediately behind symphysis pubis, at midurethra. In the stress incontinent patient, this action restores the urethral diameter from open (O) to closed (C).



Figure 2. – Radiopaque dye injected into the bladder flows into the left ureter ‘L’. The hemostat H is inserted, but no pressure has yet been exerted.



Figure 3. – Upward pressure on the anterior vaginal wall in the region of midurethra by a hemostat (H) prevents reflux.

DISCUSSION

According to a recent review,⁴ primary vesicoureteral reflux is the outcome of a congenital abnormality of the ureterovesical junction. Our hypothesis is that a lax pubourethral ligament (PUL) may be the ultimate cause not only of reflux, but also of urge and stress symptoms in childhood. We have seen many adult women and other family members with such childhood symptoms cured/improved at puberty. We attribute this to strengthening of the collagen component of the PUL by estrogen/testosterone. Those females who continue with problems into adulthood, respond well to a midurethral sling, which works by reinforcing the PUL.^{2,5,6} As patients with ureterovesical reflux also improve at puberty, we hypothesized that the same musculoelastic mechanism for urethral closure,¹ may also rely on a competent pubourethral ligament, ‘PUL’ (figure 1). According to a recent review,⁴ primary vesicoureteral reflux is the outcome of a congenital abnormality of the ureterovesical junction. Patients with ureterovesical reflux also improve at puberty. Based on our analysis of the biomechanics of all the structures in figure 1, vagina, muscle forces, ureters, urethra, we concluded that the same musculoelastic mechanism which activates urethral closure,¹ may also close the ureterovesical junction. This closure mechanism relies entirely on a competent pubourethral ligament.

Clearly a midurethral sling is not appropriate for very young females. Excellent results have been achieved for urinary symptoms by encouraging squatting, and using a large rubber ‘fitball’ instead of a chair to strengthen the pelvic muscles and their ligamentous insertions.⁷ If this does not help, a midurethral sling⁶ can be performed at an appropriate time when the patient is older.² A midurethral sling is far less invasive, and does not alter the anatomy as do the ureteral transplantation operations.

CONCLUSION

The hypothesis that a musculoelastic mechanism dependent on a competent pubourethral ligament may play a role in vesicoureteral valvular closure, appears to have been

confirmed, at least in one case. Hopefully this observation will lead to further studies, and perhaps, new directions for therapy.

REFERENCES

1. Petros PE, Von Kinsky B. Anchoring the midurethra restores bladder neck anatomy and continence, *Lancet* (1999); 354:9193:997-998.
2. Petros PEP. Chapter 7, Current and Emerging Issues, in *The Female Pelvic Floor 3rd Edition*, 2010, Petros PEP, Springer, Heidelberg, p 264.
3. Lyon RP, Marshall S, Tanagho EA. The ureteral orifice: its configurations and competency. *J Urol*. 1969; 102: 504.
4. Radmayr C, Schwentner C, Lunacek A, Karatzas A, and Oswald J. Embryology and anatomy of the vesicoureteric junction with special reference to the etiology of vesicoureteral reflux, *Therapeutic Advances in Urology*, (2010) 1(5) 243 250 DOI: 10.1177/ 1756287209348985.
5. Petros PEP. Cure of childhood urgency incontinence with a midurethral sling, *Pelviperrineology* 2009; 28: 43.
6. Sivaslioglu.A, Unlubilgin.E Aydogmus.S, Celen.E, Dolen.I. A prospective randomized controlled trial of the transobturator tape and tissue fixation system minisling in 80 patients with stress urinary incontinence - 3 year results *Pelviperrineology* 2010; 29: 56-59.
7. Petros PEP. Chapter 5, Pelvic Floor Rehabilitation according to the Integral Theory. Towards a more time efficient method for pelvic floor rehabilitation and with a wider symptom scope, in *The Female Pelvic Floor 3rd Edition*, 2010, Petros PEP, Springer, Heidelberg, pp 219-225.

Correspondence to:

ALFONS GUNNEMANN
Klinikum Lippe GmbH
Rontgenstrasse 18
32756 Detmold (Germany)

e-mail: alfons.gunnemann@klinikum-lippe.de (Alfons Gunnemann)
e-mail: kvinno@highway1.com.au (Peter Petros)