THE ROLE OF URODYNAMICS IN CHILDREN TREATED WITH BLADDER AUGMENTATION USING GASTRIC OR INTESTINAL SEGMENT FOR TREATMENT OF URINARY INCONTINENCE

PhD Thesis

Dr. Juhász Zsolt
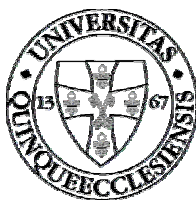
Pécs University, Department of Pediatrics

2008

THE ROLE OF URODYNAMICS IN CHILDREN TREATED WITH BLADDER AUGMENTATION USING GASTRIC OR INTESTINAL SEGMENT FOR TREATMENT OF URINARY INCONTINENCE

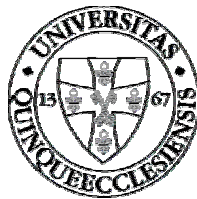**PhD Thesis**

Dr. Juhász Zsolt

Pécs University, Department of Pediatrics

Program Director: Prof. Dr. Sümegi Balázs

2008

INTRODUCTION

Surgical treatment of urinary incontinence in children

Urinary incontinence (also known as incontinentia urinae - i.u.) in childhood is usually a result of congenital anomalies (table 1), and two distinct groups of causes can be identified.

Neurogenic Causes	
Congenital	**Acquired**
Anomalies of spinal cord coverage	trauma
Caudal regression syndrome	tumor
tethered cord	Central nervous system inflammation
	iatrogenic (surgery due to high anorectal atresia)
Non-neurogenic	
bladder exstrophy	
epispadiasis totalis	
cloaca exstrophy	
"high" urogenital sinus	
cloaca	
ureteric ectopia	
ureterocele	
iatrogen (fistula, strictura)	

Table 1: Causes of urinary incontinence in childhood
(Those in italics only pseudo-incontinence)

The essence of urinary incontinence can be described with three different, yet often combining conditions:

1. *Insufficieny of urinary storage*: usually small capacity bladders unable to store urine for 3-4 hours in normal conditions.

2. *Insufficiency of urinary emptying*: (possibly) acceptable capacity bladder, yet unable to excrete urine sufficiently with significant residual volume.

3. *Insufficiency to 'hold' urine*: the capacity of the bladder may be normal, and the patient may be able to excrete urine, yet the muculature of the bladder may be diseased in a way that it may not be able to hold enough urine. There is continous dripping of urine or only small fractional excretion.

In clinical setting the above three components usually interact with each other.

In order to understand the pathomechanism and successfully treat i.u, it is imperative to know the intravesical pressures. If the bladder stores urine at a high pressure (>40 cm H_2O) and is able to excrete urine at only higher pressure values, then as a result of growing intravesical pressure the upper urinary tract is irreversibly damaged morphologically and functionally.

Such knowledge can further direct the path of therapeutic modality to be adapted in i.u. These can be the following:

- Creation of sufficient bladder capacity and intravesical pressure that does not harm the supravesical urinary tract.
- Ensure residium-free urine emptying every 3-4 hours.
- Create good urine storage and 'dryness'.

1 Insufficiecny of Urinary Storage

Primary treatment is conservative. The drug-based bladder-augmentation (oxybutynin) and CIC (clean intermittent catheterization) are effective in 85% of the cases and can lead to total 'dryness'. The anticholinergic oxybutynin and the more selective, atropine-effect-free tolterodine reduce the tone of the detrusor, improve compliance and capacity, while reducing intravesical pressure.

If the medical therapy is complimented with CIC, ensuring complete bladder emptying, continence may be achieved.

If the conservative therapy does not produce the anticipated results (maximum dose of oxybutynin 0.8 mg/kg/day) then the next in line for these 15% patients is surgical treatment – more specifically, bladder augmentation.

In order to assimilate in society it is imperative for the child to hold and store urine. This can be achieved by increasing the volume of the bladder with augmentation achieved with gastric or intestinal segment.

There is still no consensus in the international literature concerning which method of augmentation is better. Currently, the most popular modalities are *ileocystoplasty* or *colocystoplasty*. In patients with reduced renal function the procedure of *gastrocystoplasty* should be performed. Bladder augmentation may be undertaken by using the ureter (*ureterocystoplasty*).

2. Insuffiency of Urinary Emptying

In sufficient capacity bladders which do not empty spontaneously, the urine can be discharged through CIC (if the bladder neck musculature is intact). In case CIC cannot be undertaken for various reasons, then a cystostoma has to be created (between bladder and abdominal wall, at the level of the umblicus). The stoma in majority of cases is created using the appendix (Mitrofanoff stoma) or small intestine (Monti stoma). Following this CIC is significantly easier.

3. Insufficiency to 'Hold' Urine

The conservative therapeutic modalities (pelvic muscle exercise, biofeedback conditioning, use of sympatomimetics) when applied in children with incontinence due to organic/congenital causes (MMC, bladder exstrophy, etc.) usually do not yield positive results.

The urinary outlet-resistance can be modified using bladder-neck surgical techniques (Young-Dees-Leadbetter, Kroop, Pippi-Salle), bladder-neck elevation and suspension (using fascia and GORETEX strips, Burch or Stamey or Gittes surgeries), or endoscopic bladder-neck narrowing (periurethral injections of either Teflon or Macroplastique or Deflux).

Using the above mentioned techniques, bladder of decent capacity, compliance and pressure can be created. Thus, continence may be achieved, and the supravesical urinary pathway is protected. Since the patient may be dry, assimilation in society is getting easier (no need for diapers, sociable in school and workplace).

Neurogenic Bladder and VUR

The neurogenic bladder (small capacity, reduced compliance, high intravesical pressure) leads to secondary VUR (vesico-ureteral reflux). The surgical or medical increment in capacity and compliance as weel as the reduction of intravesical pressure may lead to the cessation of VUR or improve response to treatment.

There is no consensus on whether or not VUR should also be treated surgically at the time of bladder augmention (endoscopic injection). Also, it is postulated that the augmentation itself (increased capacity, compliance, reduced pressure) will result in cessation of VUR.

Urodynamics

The lower urinary tract urodynamics studies examine the bladder and the bladder-neck muscular functioning. It can delineate the pathology, and help to follow-up treatment. Urodynamics examinations can be grouped according to the following:

- *Bladder-storage examining methods:*
  - Cystometry
- *Bladder-emptying examining methods*:
  - Uroflowmetry
  - Pressure-flow study
- *Bladder-neck apparatus examination:*
  - Perineal EMG
  - Urethral pressure profile

In order to gain information concerning intravesical pressure, bladder stability, sensibility and activity, it is necessary to perform 'filling cystometry' (intravesical pressure) during which we can measure the bladder capacity (capacity according to age = 30 ml +[age (yrs) x 30ml]), intravesical pressure and abdominal (rectal) pressure. From these values we can deduct detrusor pressure (difference between intravesical and abdominal pressure) and bladder compliance ($C=\Delta V/\Delta p$). The bladder normally has a pressure less than 40 cmH$_2$O. The normal compliance is 20-25 ml/cmH$_2$O, or slightly more. The intravesical pressure is not only important to decide whether surgical or medical treatment should be employed, but also to guage the results of therapy and for long-term follow-up.

<u>AIMS</u>

1. Is the bladder augmentation itself sufficient for the treatment of vesicoureteral reflux?

2. Does the choice of bowel used for augmentation (gastric, small or large intestine) influence the values during urodynamics examinations in the detection of persisting VUR?

3. Does the type of augmentation perform (gastric, small or large intestine) influence the urodynamics studies and cessation of urinary incontinence?

4. Is stone formation influenced by the type of augmentation performed?

PATIENTS AND MATERIALS

Examinations were performed at the Department of Pediatrics, Faculty of General Medicine, University of Pécs. Two examinations at different intervals were performed in patients who had bladder augmentation.

The first examination considered the urodymical aspects of patients who underwent augmentation and simaltaneously had VUR, until 2004. We evaluated whether different types of augmentations (using different bowel segments) had an influence on the degree of VUR postoperatively, and whether VUR would cease without surgery.

During the second examination different types of augmentation techniques and urinary incontinence were compared urodynamically, between the period 1987-2006. Also, the frequency of stone formation was evaluated in all cases of bladder augmentation.

All patients who underwent bladder augmentation were thorougly examined 3, 6 and 12 months postoperatively, later on annually until the fourth postoperative year, then biannually. Besides urodynamical examinations, blood film and urine samples were examined. Also, ultrasound, *MCU*, DMSA and DEXA were performed (the results of these examinations are not part of the present thesis).

The urodynamics examinations were performed in alert state, we only rarely used light sedation with Dormicum (in infants and small children). Technically, dynamic perfusion cystometry was used with biluminal transurethral catheter, simaltaneously measuring abdominal (rectal pressure) with video column and fluid-bridge pressuer measurement. Occasionally, perineal EMG was also performed. During the examination the empty bladder was filled with slow-flow, body temperature saline.

1. Augmentation and VUR

Between 11 August 1987 and 31 December 2004, we examined 63 patients who underwent bladder augmentation at our unit. Majority of these patients (45 patients, 65%) also received abdominal wall cystostoma, which enabled them to perform CIC on their own, thus rendering them continent.

Out of the 63 patients, VUR was documented in 26 cases (33 ureters) before the augmentation. Out of these, 12 had low grade (I-II) VUR, whereas 21 ureters showed high-grade reflux (III-V). Pateints were placed in 2 groups accordingly: 1) augmentation and anti-reflux procedure in one sitting, or 2) on separate occasions.

In the initial phase all patients with high-grade VUR were neoimplanted (or rarely, STING) simaltaneously with the augmentation procedure. Later on only selected cases of VUR (grade V or paraurethral diverticulum received antireflux surgery – irrespective of the high intravesical pressure.

Group 1 involved 10 patients (16 refluxing ureters) who had augmentation and anti-reflux procedures performed in one sitting. Average age of patients at surgery was 11.6 years (7-17 years. Of the 10 patients 9 had antireflux surgery (14 ureters), whereas 1 patient had bilateral Teflon injection (STING) at time of augmentation. There was grade III-V VUR in 13 ureters (81.3%), whereas 3 ureters showed lower-grade (II, 18.7%) reflux (diagram 1). Six out of 10 patients had MMC and 4 had non-neurogenic bladders (2 bladder exstrophies, 1 epispadias and 1 had another condition). Five patients received augmentation with large intestinal segment, 3 with gastric segment and 2 with small intestinal segment. In 8 patients treated conservatively, small capacity bladder with poor compliance, increased intravesical pressures and i.u were the indications for a later augmentation procedure. Two patients did gain continence but the intravesical pressure remained high with poor compliance, leading to an eventual bladder augmentation.

Group 2 contained 16 patients (17 refluxing ureters). These patients did not have a reflux procedure during bladder augmentation. Eight patients (47%) had grade III-V VUR, whereas 9 others showed a lower grade reflux (53%, diagram 2). Of these patients 8 had MMC and 8 others had non-neurogenic bladders (5 bladder exstrophy, 1 anorectal malformation, 1 other condition). These patients did not undergo surgical or endoscopic anti-reflux procedures. Seven patients had large-intestinal segment augmentation, 6 gastric segment and 3 patients had small intestinal segment augmentation. Average age at time of surgery was 10.9 years (4-17 years). The indication for bladder augmentation in 12 patients was small capacity bladder, increased intravesical pressure and reduced compliance, which led to the failure of conservative treatment and persisting incontinence. Four patients, though continent, showed reduced compliance and intravesical pressure – leading to bladder augmentation.

Prior to augmentation, in both groups, cystometry was performed to measure bladder capacity, maximal intravesical pressure and compliance. Urodynamics study results were evaluated before and after augmentation procedures (last study during the follow-up). The results were statistically examined according to the Student t-test (significance: $p<0.05$).

With the help of MCU, the course of VUR was examined. The aim here was to evaluate whether or not the segment used for augmentation influenced the cessation of the persistence

of VUR. The average follow-up period in group 1 patients was 5 years (1-13 years), whereas group 2 patients were followed up to 6.2 years on average (1-13 years).

2. Comparison of different types of augmentation

Between 11 August 1987 and 31 December 2006, 77 patients had bladder augmentation. 1 patient, unble to attend the follow-up after 3 months post-operatively, was excluded from the study. Of the 76, 53 (70%) had a catheterazable continent abdominal wall cystostoma (41 with appendix, 5 Monti, 6 ureter and 1 continent fistula).

The patients were placed in 3 groups, considering which bowel segment of the three was used for the bladder augmentation. We also examined the data collected from patients suffering from neurogenic and non-neurogenic bladders.

- We examined that in what extent the bowel segment used for augmentation influences urodynamical changes and the development of continence in the bladder augmented (clinical observation, napkin-test).
- We examined the frequency of bladder stone formation in the three types of augmentation. The causes of stone formation (urine infection, metabolics changes, etc.) and the analysis of extracted stones (number, size, chemical make-up) are not discussed in the present thesis.

In all the three groups pre and post augmentation cystometry was performed to measure the bladder capacity, compliance and maximal intravesical pressure. The results of these studies were compared and evaluated according to the Student t-test (significance: $p < 0.05$).

Group 1 patients (large intestine segment) contained 34 patients (24 sigmoid colon, 10 cecum-ascending colon) with augmentation. Average age at surgery was 9.2 years (6-20 years). Indication for surgery in 33 patients was failure of conservative treatment and incontinence. 28 patients received an abdominal wall stoma (82%), whereas 6 could perform CIC through the urethra (18%).

18 patients of group 2 had gastric segment bladder augmentation. Average age at surgery was 13.22 years (6-20 years). Nine patients underwent augmentation following failure of conservative therapy and persisting incontinence (50%). The other 9 patients had augmentation inspite of being continent since the results of the urodynamics study were unfavourable. Six patients (33%) perform CIC through the abdominal wall stoma, whereas the remaining perform it through the urethra (67%).

Group 3 patients contained 24 patients who had augmentation with small intestinal segment. Average age at surgery was 10.62 years (4-23 years). In all the patients the indication for sur-

gery was incontince following failure of conservative treatment. Of this patient group 19 perform CIC through their abdominal wall stomas (79%). whereas the other 5 perform it through the urethra (21%).

The average follow-up period in group 1 was 9.2 years (1-20 years), in group 2 was 8.05 years (1-14 years) and in group 3 was 2.29 years (1-4 years).

RESULTS

1. Augmentation and VUR

On an average, 11 months (3-72 months) post-augmentation, VUR ceased to exist in all the patients in group 1 (100%). Recurrence of VUR was seen in 2 patients (12.5%). In one patient, who had gastrocystoplasty and bilateral STING injection (bilateral VUR, grade II) in one siting, a grade III VUR was identified 3 years postoperaively in one ureter. This was treated successfully with 2 years of oxybutynin. In one other patient grade III VUR was detected 6 months postoperatively, following augmentation with the small intestine. This reflux ceased spontaneously as it was not seen on the 1-year follow-up (diagram 1).
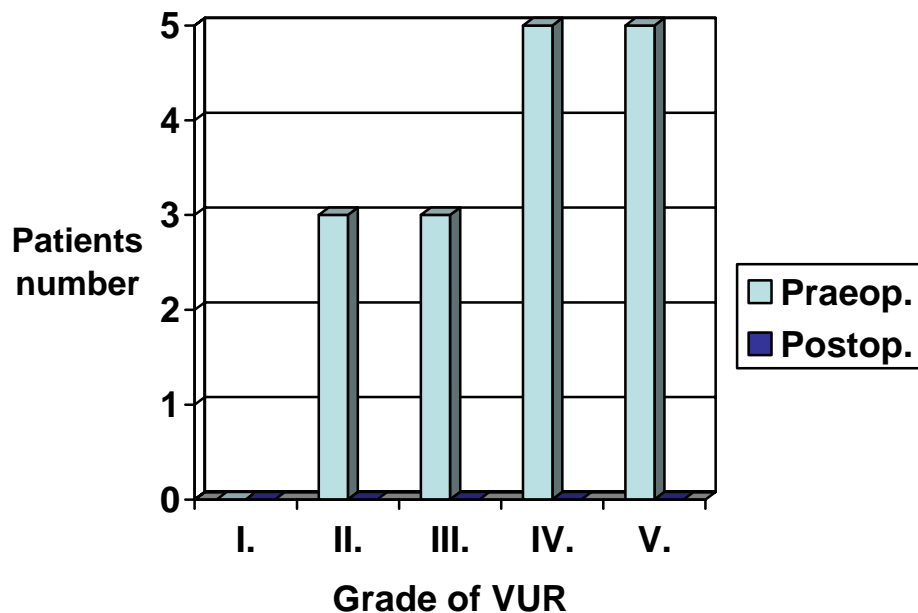

Diagram 1: Number of patients and grade of VUR in patients operated with augmentation and simaltaneous anti-reflux treatment

During follow-up of group 1 patients, the pre-augmentation bladder capacity was 166.1 ml (24-440 ml). This increased to 446.1 ml (385-480 ml) postoperatively (p=0.01). The average compliance increased from 5.7 ml/cmH$_2$O (1.3-16) to 43.7 ml/cmH$_2$O (10,6-89), p=0.01. The average maximal intravesical pressure under filling reduced from 57.4 cmH$_2$O (28-134) to 28.7 cmH$_2$O (16-60), p=0.021. In the postoperative period the attained compliance, intravesical pressure and the bladder capacity did not depend on the type of bowel segment used for the augmentation. Only the patients who received gastrocystoplasty did not have significantly

improved values. The cessation of VUR also did not depend on the type of bowel segment used for bladder augmentation.

In 14 (15 ureters – 88.3%) out of 16 patients in group II (17 ureters), VUR ceased in 13.6 months (3-108 months) following augmentation. The degree of VUR did not affect the period in which the reflux stopped. In 2 patients (2 ureters, 11.7%) VUR did not stop following augmentation. In one patient, who received gastrocystoplasty, a unilateral grade I VUR progressed to a grade IV bilateral VUR. This patient received an anti-reflux procedure 4 years following the augmentation. One other patient with colocystoplasty demonstrates a unilateral grade III VUR, which persists 3 years following augmentation. This patient did neither show clinical (pyelonephritis, recurring urinary tract infection) nor radiological signs (increased VUR grading, parenchymal damage, deteriorating renal function). In another 2 patients (2 ureter – 11.7%) transient VUR recurrence was seen (grade I), which resolved spontaneously (diagram 2).
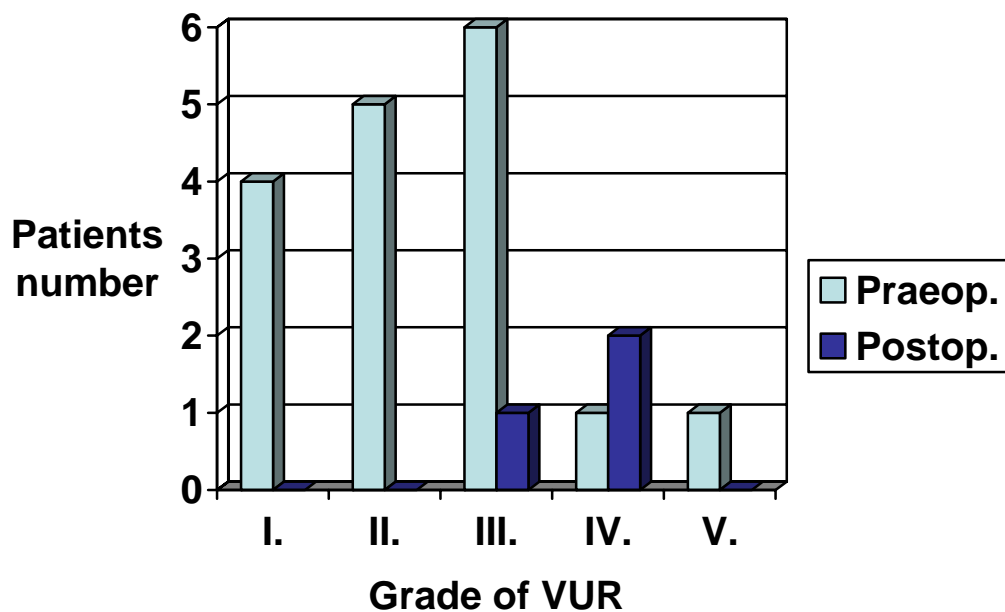

Diagram 2: Distribution according to grading of VUR in patients augmented without reimplantation (group 2).

Patients in group 2 had a pre-augmentation bladder capacity of 131.6 ml (20-300 ml), which increased to 446.8 ml (290-510 ml) in the postoperative phase (p=0,001). The average compliance increased from 4.3 ml/cmH$_2$O (2-9.2 ml/cmH$_2$O) to 40.2 ml/cmH$_2$O (13.3-72 ml/cmH$_2$O), p=0.001. The average maximal intravesical pressure on filling reduced from 57.4 cmH$_2$O (28-134 ml/cmH$_2$O) to 26.9 ml/cmH$_2$O (12-43 ml/cmH$_2$O), p=0.003. The type of

segment used for augmentation did not have an impact on the compliance, capacity or intravesical pressure. The cessation of VUR did not was influenced by the kind of segment used for augmentation, either.

On comparing the average capacity, compliance and the maximal intravesical pressure measured following augmentation in groups 1 and 2 (26 patients), significant difference was found only in the maximal intravescical pressure of those having undergone ileocystoplasty. From the point of cessation of VUR (group 1 100%, group 2 83%) there was no significant difference (p=0.168) between the two groups.

2. Comparison of different types of augmentation

2.1 Urodynamics study and continence

In group 1 patients (colocystoplasty) 14 (41%) had nerogenic bladder and 20 (59%) had non-neurogenic bladders.

During the follow-up of this group, average pre-augmentation compliance was 3.7 ml/cmH$_2$O (1-12) which increased to 47.3 ml/cmH$_2$O (20,5-90) postoperatively, p<0.001. The bladder capacity increased from an average of 140.9 ml (10-460) to 450.9 ml (370-510) in the postoperative period, p<0.001. Similarly, the the maximal intravesical pressure reduced from 51.5 cmH$_2$O (10-134) to 25.9 cmH$_2$O (17-41), p=0.001. The changes in the bladder capacity, compliance and maximal intravesical pressure of patients with neurogenic bladder were the most significant. Patients with non-neurogenic bladder had significant improvement in compliance and bladder capacity, whereas maximal intravesical pressure did not improve significantly.

In group 1 patients, prior to augmentation, pathological detrusor contractions were noticed in 9 patients (26%, neurogenic bladder – 6 patients, non-neurogenic bladder 3 patients). Postoperatively, following detubularisation, pathological contractions could be measured in 22 patients (68%, neurogenic bladder - 10, non-neurogenic bladder - 12 patients). Eight patients had to be put on anticholinergic treatment (23%).

Pre-augmentation, in group 1 patients, 33 out of 34 patients were incontinent. Following augmentation, 26 of them became dry (continent), 6 patients remained slightly incontinent (18% - sanitary pads sufficient) and 2 patients remained incontinent (6%, diagram 3). In these patients the sphincter mechanism was insufficient, requiring a repair surgery later.
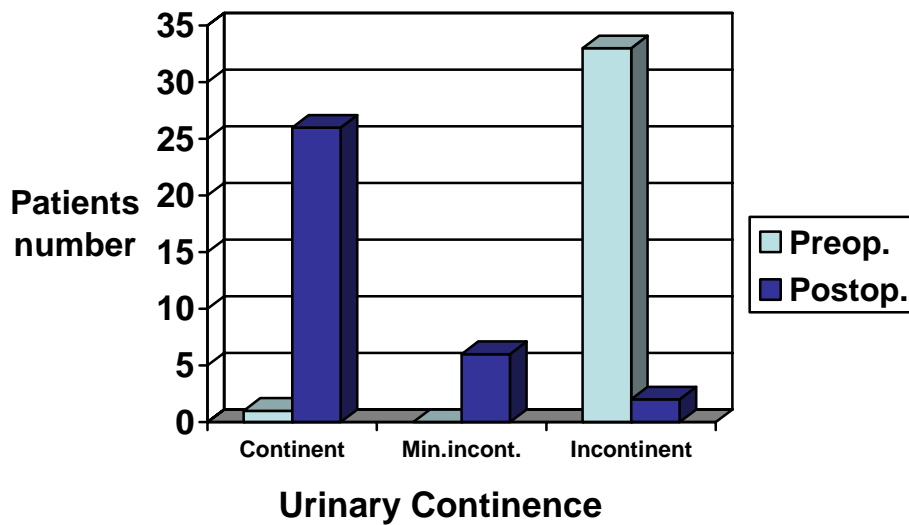
Diagram 3: Changes of continence before and after augmentation – colocystoplasty (group 1)

Group 2 patients had gastrocystoplasty. Seventeen (95%) patients had neurogenic bladders, 1 patient (5%) had non-neurogenic bladder.

During follow-up the preoperative compliance was 6.5 ml/cmH$_2$O (1-12.5), and rose to 31.6 ml/cmH$_2$O (15-55, p<0.001) postoperatively. The average bladder capacity rose from 215.6 ml (30-440) preoperatively, to 423.5 ml (250-480) postoperatively, p<0.001. The maximal intravesical pressure reduced from 58.1 cmH$_2$O (28-90) to 29.6 cmH$_2$O (19-45) in the post-augmentation period, p<0,001. The compliance, bladder capacity and maximal intravesical pressure in the neurogenic bladder group improved significantly. In the non-neurogenic bladder sub-group significant improvement could not been measured in one patient, but overall the improvement was obvious.

Prior to augmentation, 2 patients (11%) in group 2 had pathological over-functioning of the detrussor (2 neurogenic bladders). In the postoperative phase 12 patients (66%) showed pathological contractions, in particularly with the gastric segment augmentation (12 neurogenic bladders). Amongst these patients 2 patients had to be put on postoperative anticholinergic therapy (11%).

Nine out of 18 patients in group 2 had incontinence preoperatively. Fifteen patients (83%) turned continent following augmentation, 3 maintained slight incontinence (17 %, used sanitary pads alone). No patient remained remained totally incontinent (diagram 4).
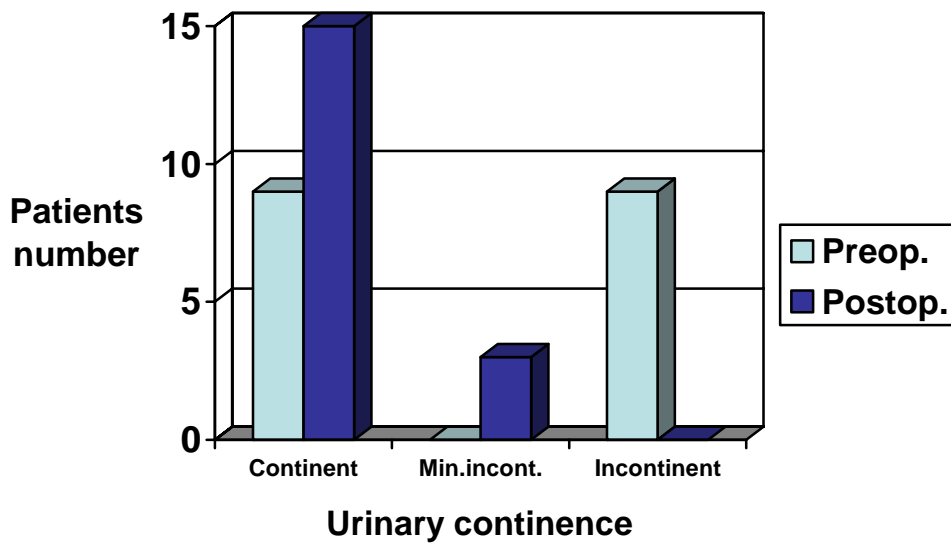
Diagram 4: Changes of continence before and after augmentation – gastrocystoplasty (group 2)

In group 3 patients (ileocystoplasty) we had 17 neurogenic bladders (71%) and 7 non-neurogenic bladders (29%). Preoperatively, the average compliance measured was 6.1 ml/cmH$_2$O (1.3-13-6). Postoperatively, this rose to 34.1 ml/cmH$_2$O (14.2-64, p<0,001).

The average bladder capacity rose from 165.2 ml (16-450) to 393.1 ml (220-465, p<0,001). The highest intravesical pressure measured preoperatively was 41.4 cmH$_2$O (20-68). This reduced to 27 cmH$_2$O (19-39, p=0,002). Patients belonging to the group of patients suffering from neurogenic bladder had significant change in compliance, capacity and maximal intravesical pressure. Patients with non-neurogenic bladder demonstrated similar improvements except for the maximal intravesical pressure, which did not change remarkably.

Prior to augmentation in group 3 patients, 9 (38%) showed pathological over-functioning of the detrussor (neurogenic bladder - 8, non-neurogenic bladder - 1 patient). Postoperatively, in spite of detubularisation 7 patients (29%) demonstrated pathological bladder contractions (neurogenicbladder - 5, non-neurogenicbladder - 2 patients). Out of 24 patients, 11 patients required postoperative anticholinergic treatment (46%) partly due to unmanagable contractions partly because the intravesical pressure was not normalised. Patients with an ileocystoplasty were followed-up for the shortest period of time since this surgery was adopted the latest. In our patients we make an effort to continue the anticholinergic treatment for 6 months to 1 year in order to stabilize the augmented bladder.

In group 3, all the 24 patients were incontinent before the augmentation. Following surgery 21 patients became continent (87%), 1 patient remained slightly continent (5%, only used sani-

tary pads), 2 patients remained incontinent (8%). Of these 2 patients 1 patient had insufficiency of the bladder-neck musculature and therefore would undergo corrective surgery, whereas another patient is booked for revision of the cystostoma (diagram 5).
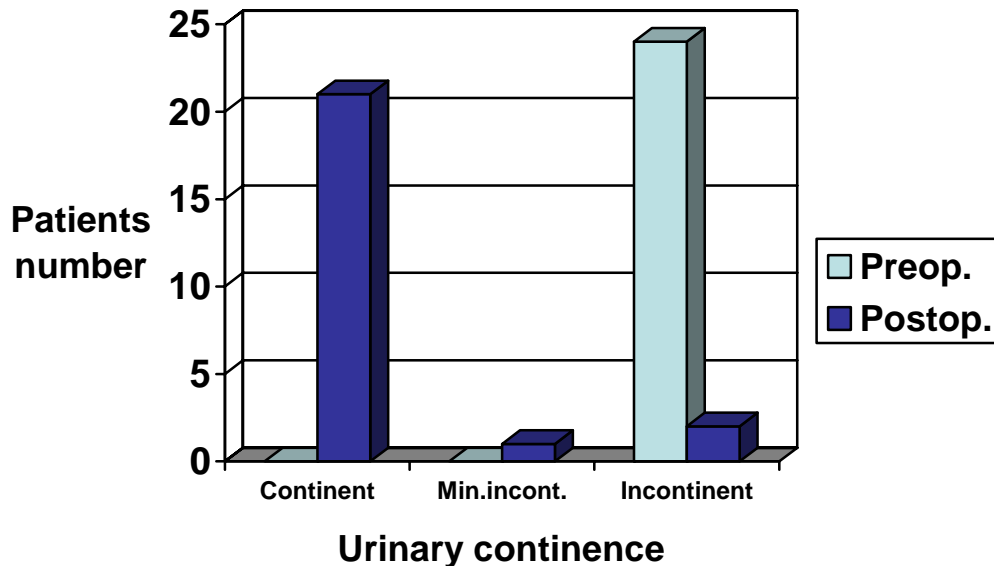

Diagram 5: Changes of continence before and after augmentation – ileocystoplasty (group 3)

Finally, comparing the urodynamical results of the three bowel segments used for augmentation, it can be concluded that all the three methods show favourable improvements in increasing capacity, improving compliance and in reducing intravesical pressure.

2.2 Stone formation in bladder

Group 1 (colocystoplasty) contained 34 patients with 14 demonstrating stone formation (41%). All stones were removed {neurogenic bladder – 6/14 (43%), non-neurogenic bladder – 8/20 (33%) patients}. Four patients had recurrent stone in the bladder {4/34 - 12%, 1 neurogenic bladder patient (1/14 – 7%), 3 non-neurogenic bladders (3/20 – 15%)}. Out of the 14 patients, 12 regularly performed CIC through the cystostoma {86%, neurogenic - 5, non-neurogenic - 7), whereas 2 performed CIC through the urethra (14%) ($p < 0.05$).

No stone formation was detected in patients of group 2, where gastrocystoplasty was performed.

In group 3, where ileocystoplasty was performed, 2 out of 24 (2/24) patients demonstrated bladder stones {8%, neurogenic – 1/17 (6%), non-neurogenic – 1/7 (14%) requiring removal.

One neurogenic-bladder patient had stone recurrence. In both patients with bladder stones, a continent stoma was created simaltaneously with bladder augmentation surgery.

Diagram 6 demonstrates the frequency of stone formation in augmented bladders of all the three groups.

In accordance with the recommendations in the international literature, the smaller stones were removed endoscopically, whereas the larger ones were extracted through cystostomy.
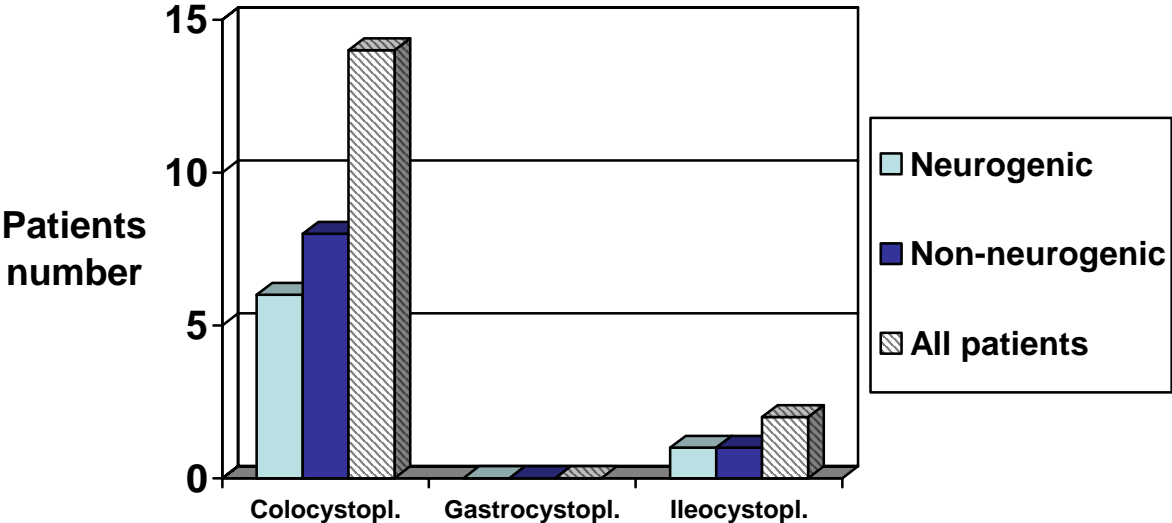
Diag. 6: Frequency of bladder stone formation in augmented patients

SUMMARY

1. Augmentation and VUR

Successful augmentation alone may be sufficient in the cessation of lower and higher grade VUR. Amongst our patients those with bladder augmentation initially underwent antireflux surgery, but later 87% VUR resolved without the reimplantation of the ureters. The literature also mentions 87.5% resolution in higher grade VUR. Although patients with gastrocysto-plasty had poorer results when compared to patients with colocystoplasty or ileocystoplasty the different types of bowel segments used for augmentation neither influence the results of the urodynamics examinations nor do they affect the state of the VUR.

2. Comparisons of different types of augmentation

2.1 Urodynamics and continence

Following bladder augmentation, urodynamical values were favourable irrespective of the bowel segment used. It was noticed that in patients with non-neurogenic bladders who had augmentation with small or large bowel segments, the intravesical pressure reduction was not significant. Of all the post-augmented bladders, incontinence ceased in 95%, whereas it per-sisted in 5% of patients (they will require continence-surgery later). The bowel segment used for augmentation does not influence the result of the surgery or cessation of incontinence. Urodynamics studies in the postoperative phase have revealed pathological contractions in 60% of patients' bladders where stomach or large intestinal segments were used. In cases of ileocystoplasty, the frequency for such contrations was around 30%.

2.2 Stone formation in augmented bladders

The frequency of bladder stones significantly varied with the type of bowel segment used for augmentation. In patients with colocystoplasty the rate of stone formation was 41%. whereas in patients with ileocystoplasty it was only 8%. Stone formation was not seen in patients with gastrocystoplasty. Also, CIC performed through continent adominal wall cystostoma in-creases the risk of stones in the augmented bladder.

CONCLUSIONS DERIVED FROM THE PRESENT THESIS

1. In accordance with the few international publications in this field it can be concluded that bladder augmentation alone can be sufficient for the cessation of VUR. This applies to both low and high-grade refluxes.

2. Our results prove that the type of bowel used for augentation does not significantly influence cessation of VUR. This has not been reported in the literature yet.

3. Following augmentation, favourable urodynamical results were obtained, irrespective of the bowel segment used.

4. Favourable urodynamical values following augmentation demonstrate significant improvement or cessation of incontinence, irrespective of the type of bowel segments used for surgery.

5. Augmentation with small intestinal segment resulted in fewer pathological contractions.

6. Stone formation was the least frequent following augmentation with gastrocystoplasty, and ileocystoplasty. It was the most common following colocystoplasty.

7. A continent abdominal wall stoma in augmented bladders significantly increases the incidence of stone formation.

PUBLICATIONS IN THE BACKGROUND OF THE PRESENT THESIS

Articles

1. Hock A., **Juhász Zs.**:
   A meningomyelocelés betegek urológiai rehabilitációja
   Rehabilitáció (Magyar Rehabilitációs Társ. folyóirata), 1998; 8: 6-8.
2. **Juhász Zs.**, Jainsch M., Hock A., Farkas A., Pintér A.:
   Az urodinamia helye és értéke gyermekekben végzett húgyhólyagmegnagyobítás és pótlás nyomonkövetésében.
   Orv. Hetil., 2000; 141: 1561-1565.
3. Vajda P., Pintér A., Vástyán A., **Juhász Zs.**, Oberritter Zs.:
   Gastrocystoplastica nyulakban – egy állatkísérletes modell kialakításának nehézségei.
   Magyar Urológia (Kísérletes Urológia), 2000; 12: 35-41.
4. **Juhász Zs.**, Oberritter Zs., Farkas A., Vajda P., Vástyán A., Pintér A.: Az urodinámia helye a gyermekkori vizeletincontinentiák kezelésének megválasztásában
   Rehabilitáció, 2001; 11: 7-9.
5. Farkas A., Pintér A., Vajda P., **Juhász Zs.**, Vástyán A. és Oberritter Zs.: A húgyhólyag gyermekkorban végzett sebészi megnagyobbításának középtávú eredményei
   Orvosi Hetilap, 2001; 142: 1617-1621.
6. Pintér András, Vajda Péter, Farkas András, **Juhász Zsolt**, Vástyán Attila, Oberritter Zsolt: Incontinentia urinae gyermekkorban – kórismézés és kezelés, pécsi algoritmus.
   Gyermekgyógyászat, 2001; 52: 609-618.
7. Pintér András, Oberritter Zsolt, **Juhász Zsolt**, Sándor György: „…és amikor a vesicoureteralis reflux kezelési lehetőségei kimerültek"
   Hypertonia és nephrológia, 2001; 5: 137-143.
8. Vajda Péter, Pintér András, Farkas András, **Juhász Zsolt**, Vástyán Attila, Oberritter Zsolt: A húgyhólyag ismételt megnagyobbítása (re-augmentatio)
   Magyar Urológia, 2002; 14: 207-213.
9. Pintér András, Farkas András, Vajda Péter, **Juhász Zsolt**, Vástyán Attila: Indikációs és műtéttechnikai különbségek a gyermekkorban és a felnőttkorban végzett hólyagmegnagyobbító és –pótló beavatkozások között. (**idézhető absztrakt**)
   Magyar Urológia, 2003; 15: 109.
10. Oberritter Zs., Somogyi R., **Juhász Zs.**, Sándor Gy., Pintér A.: Vesico-ureteralis reflux endoszkópos kezelése
    Családorvosi Fórum, 2004; 3: 48-51.
11. Somogyi Réka, Oberritter Zsolt, **Juhász Zsolt**, Vajda Péter, dr. Pintér A.: Vesicoureteralis reflux kísérletes létrehozása sertésben.
    Magyar Urológia, 2004; 16: 165-170.
12. Vástyán Attila, Pintér András, Farkas András, Vajda Péter, **Juhász Zsolt**, Oberritter Zsolt, Fathi Khaled: Műtéti húgyhólyag-megnagyobbítás gyomorszegmentummal – gastrocystoplastica
    Gyermekgyógyászat, 2004; 56: 67-72.
13. Peter Vajda, Andrew B. Pinter, Tamas Magyarlaki, Attila M. Vastyan, **Zsolt Juhasz**, Zsolt Oberritter, Khaled, Fathi: Histological findings after gastrocystoplasty in rabbits
    J. Pediatr. Surg., 2005; 40: 1470-1474.   *IF$_{2005}$: 1.125*
14. Peter Vajda, Cenk S.N. Buyukunal, Yunus Soylet, Nur Danismed, **Zsolt Juhasz** and Andrew B. Pinter: A therapeutic method for failed bladder augmentation in children: re-augmentation
    BJU Int, 2006; 97: 816-819; discussion 819.   *IF$_{2006}$: 2.635*

15. Kispál Zoltán, Vajda Péter, Vástyán Attila, **Juhász Zsolt**, Pintér András:
Új kísérletes modell kutyákban: a húgyhólyag gyomorral és vastagbéllel egyidejűleg történő megnagyobbítása – kompozit hólyag
Magyar Urológia, 2006; 18: 230-237.
16. **Juhász Zsolt**, Oberritter Zsolt, Sándor György:
Dysfunkcionális vizelés gyermekkorban
MOTESZ Magazin, 2006; 3: 56-58.
17. **Juhász Zsolt**, Oberritter Zsolt, Vajda Péter:
Vizelettárolási, vizeletürítési és vizelettartási elégtelenségek sebészi kezelése gyermekkorban
Gyermekorvos Továbbképzés, 2007; 4: 146-150.
18. Oberritter Zsolt, Somogyi Réka, **Juhász Zsolt**, Pintér András
Vesicoureteralis reflux subureticus Teflon-injektálással történő kezelése: hosszú távú eredmények
Gyermekgyógyászat, 2007; 58: 269-272.
19. Sándor György, **Juhász Zsolt**, Oberritter Zsolt, Csekéné Mohai Csilla, Gyuris Petra, Fülöp Szilvia
A gyermekkori nem-neurogén eredetű hólyagműködési zavarok és incontinentia komplex therápiás és rehabilitációs lehetőségei (II.rész)
Családorvosi Fórum, 2007; 1: 24-29.
20. **Juhász Zs.**, Oberritter ZS., Vajda P.:
Vizelettárolási, vizeletürítési és vizelettartási elégtelenségek kezelése gyermekkorban
Gyermekorvos továbbképzés, 2007; 6: 146-51.
21. **Juhasz Zs**, Somogyi R, Vajda P, Oberritter Zs, Fathi F, Pinter AB: Does the type of bladder augmentation influence the resolution of pre-existing vesicoureteral reflux? Urodynamic studies.
Neurourol and Urodyn, 2007; 26: 1-5. *IF$_{2006}$: 2.688*
22. Oberritter Zs., Somogyi R., **Juhasz Zs.**, Pinter AB:
Role of the Teflon depositi in the recurrence of vesicoureteral reflux
Pediatr. Nephrol, 2008; 23: 775-8. *IF$_{2006}$: 2.007*
23. Pinter AB, Vajda P, **Juhasz Zs**: Bladder Augmentation in childhood: Metabolic consequences and surgical complications – Review and own investigations.
J Pediatr Surg Spec, 2008; 2: 10-15.

Book Chapters

1. Pintér András, **Juhász Zsolt**
A vizeletinkontinencia sebészi kezelése gyermekkorban
Inkontinencia (diagnosztika, terápia, rehabilitáció)
Szerk.: Katona Ferenc, Hamvas Antal, Klauber András
Medicina, 2006; 186-201.

Various Other Publications

1. Pintér András, Farkas András, Vajda Péter, **Juhász Zsolt**, Oberritter Zsolt: Nem kielégítően kezelt cloaca malformációk késői rekonstrukciós műtétei
Magyar Sebészet, 2002; 55: 379-383.
2. A.M. Vástyán, A.B. Pinter, A. Farkas, P. Vajda, R. Somogyi, **Zs. Juhasz**:
Cutaneous vesicostomy revisited – the second 15 year
Eur J. Pediatr Surg, 2005; 15:170-174. *IF$_{2005}$: 0.469*

3. Vástyán Attila, Pintér András, Oberritter Zsolt, **Juhász Zsolt**, Vajda Péter:
   Currarino-szindróma, egy kevéssé ismert entitás – Case report
   Gyermekgyógyászat, 2007; 58: 288-290.

ACKNOWLEDGMENTS