Muscular (contracture) spasm of the bladder and urodynamic abnormalities in newborn and infants with refluxing megaureter

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Abstract

Spasmul (contractura) al mușchilor vezicii urinare și dereglările urodinamice la nou-născuți și sugari cu megaureter refluxant

Scopul lucrării a fost în aprecierea dereglărilor urodinamice cauzate de spasmul muscular al vezicii urinare la nou-născuți și sugari cu megaureter refluxant.
Din 71 copii de vârstă mică cu megaureter refluxant la renoscintigrafie dinamică în 99% curbele de evacuare sunt obstructive. Uneori cauzele refluxului nu se încadrează în cele cunoscute până în prezent, impunându-se mai multe întrebări, inclusiv de ce de rând cu stenoza ureterului în joncțiunea uretero-vezicală, confirmată intraoperator, se depistează și reflux sau de ce în lipsa stenozei constatate intraoperator ureterul dilatat se revarsă direct în vezică?
De rând cu cauzele cunoscute mai este o patologie neurologică – spasm (contractura) muscular al organelor pelviene – ureterul distal (segmentul Waldeyer), vezica urinară, colul vezical, sfincterul uretral extern la băieți și meatal la fetițe ceea ce duce la afectarea gravă al tractului urinar adiacent.
Diagnosticul a inclus: ecografia, electromiografia mușchilor abdominali suprapubieni sau perineali, cistouretrografia micțională, cistometria, renoscintigrafia dinamică. Toți pacienții au fost consultați de neurolog.
Tratamentul începe cât mai precoce – sondă vezicală, spasmolitici, proceduri fizioterapeutice, masaj, hidro- și kinetoterapie pentru a micșora spasmul și presiunea intravezicală. Apoi se aplică operații antireflux intravezicale de tip Cohen, Leadbetter-Politano, endoscopic contemporane cu injectare subureterală.
În cazul stenozei – rezecția segmentului stenozat cu neoimplantarea, ca și în cazul fără stenoze, pentru că în așa caz segmentul intramural este stenozat și fibrozat de mușchii vezicii urinare și presiunea intravezicală vădit mărită. După operație – monitorizare și tratament de lungă durată cu uroseptici, spasmolitici, (presiunea intravezicală greu se normalizează) sub controlul ecografiei și cistometriei.

Cuvinte cheie: megaureter, stenoza ureterului, reflux vezico-ureteral, diagnostic, tratament

Abstract

Purpose. To assess urodynamic abnormalities caused by the bladder muscle spasm in newborns and infants with refluxing megaureter.

In 71 cases of children with reflux megaureter at dynamic renoscintigraphy, 99% of the escape curves are obstructive. Sometimes the causes of reflux do not fit into the known ones so far, with ureter stenosis in the uretero-bladder junction, confirmed intraoperatively, and reflux is detected? Why, in the absence of stenosis found intraoperatively, does the dilated ureter flow directly into the bladder?

Common with the known causes is a neurological pathology - muscle spasm (contracture) of the pelvic organs - the distal ureter (Waldeyer segment), the urinary bladder, the bladder, the external urethral sphincter in boys and the flesh in girls, which leads to severe tract damage. adjacent urine.

The diagnosis includes: ultrasound, electromyography of the suprapubian or perineal abdominal muscles, micturition cystourethrography, cystometry, dynamic renoscintigraphy, consultation of the neurologist.

The treatment starts as early as possible - bladder probe, spasmolytics, physiotherapeutic procedures, massage, hydro- and kinetic therapy to reduce spasms and intravesical pressure. Then, Cohen, Leadbetter-Politano, contemporary endoscopic suburethral injection anti-reflux surgery is applied. In the case of stenosis - resection of the stenosis segment with neoimplantation, as in the case without stenoses, because in this case the intramural segment is stenosis and fibrosis of the bladder muscles and the clearly increased intravesical pressure. After surgery - a long-term monitoring and treatment with uroseptics, spasmolytics, (intravesical pressure is hard to normalize) under the control of ultrasound and cystometry.

Keywords: megaureter, ureteral stenosis, vesicoureteral reflux, diagnostic, treatment

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Studying the *vesicoureteral* reflux (VUR) for several years has contributed to the early detection of the cause and treatment optimization [3, 5, 7, 18].

When clinicians often do not know the cause of the disorders, they treat them as a neurogenic disorder. In case of the bladder, when clinicians do not find the cause of a serious disorder, it is considered to be a neurogenic bladder. But for what reason, what the clinicians have to treat is a problem. Until recently patients with micturition disorders, related to bladder *abnormalities*, have been treated as hypertonic and neurogenic bladder, the last few years – as overactive bladder [14, 15]. But what happens in the bladder, how should patients be treated? What should the treatment include? This group of patients is also treated by neurologists and urologists [2, 10] , but unfortunately without great success.

The effectiveness of the *vesicoureteral* junction in preventing vesicoureteral reflux, but also the functional mechanism are described by Bell (1812) and Young in 1897. In 1903, Sampson and Young described the functional mechanism of the vesicoureteral valve created through the oblique ureteral passage in the intramural portion, which urologists rely on to date. In 1992 Gruber noted that the incidence of VUR varies depending on the length of the intravesical ureter and the condition of the detrusor muscles [1].

Our clinic has been studying VUR since the `60s of the last century [2, 4, 6, 9]. We have tried to implement the literature data and our clinic experience. We have obtained satisfactory results both in diagnosis and treatment, but there are some issues that are not included in the reflux causes known today [11].

Known causes of the VUR etiology [3, 12, 17].

1. Shortened intramural portion of the ureter.
2. Lateralization of the ureteral orifice.
3. Recurrent urinary tract infection leads to the ureteral ostium dysfunction, morphological changes lead to intramural ureteral sclerosis, periureteritis with the disturbance of the *vesicoureteral* segment, muscular fibrosis of the Waldeyer`s sheath.
4. Infravesicular obstruction.

But there are still a number of questions not included in these cases - the dynamic renal scintigraphy performed in 71 children with reflux revealed that in 99% there are obstructed curves in the juxtavesical segment:

- Why do not these children stand the Nelaton catheter?
- Why at MCUG with reflux at urination the dilated ureters are full and tense with contrast agent or radionuclides.
- Why is urethral stenosis in the juxtavesical segment visualized and confirmed intraoperatively along with reflux at MCUG. Along the ureter only in this segment there are additional muscles - the Waldeyer sheath.

The question is why along with the *vesicoureteral* segment obstruction, there is also reflux. An increased intravesical pressure is required for the bladder contents to pass through the stenosed segment. Therefore the pressure increases, being often found in many children.

Why is not the reflux found after the antireflux operation? But the ureter dilatation is maintained, the reflux and nephropathy progress as well as the renal parenchyma healing occurs [8, 13, 16]. Initially we considered that this phenomenon is related to errors during the operation, inadequate application of sutures.

Another situation - when during the operation the stenosed segment is missing, but the dilated ureter directly pours into the bladder

We considered that dilation is the result of the hypotonic ureter. Although during the operation, after its sectioning the urine is poured in jet, the scintigraphy recorded contractions, showing that the ureter contracts to expel the bladder contents.

Therefore, besides the causes described above there is a neurogenic dysfunction: spasm, general and selective muscular contracture of the pelvic organs - distal ureter, bladder, bladder neck, urethra with marked spasm, which leads to urodynamic disorders of the lower urinary tract with the severe involvement of the kidneys, ureters, and bladder.

Muscle contracture is considered an excess of muscle tone, by maintaining an increased intramuscular tension which permanently presses on the intramuscular vessels and capillaries, causing an intramuscular circulatory deficiency, which in turn gives rise to muscular hypoxia.

In these conditions the muscles do not relax and are in contracture. This area, depending on the location, remains rigid and non-functional.

The most common muscle contractures occur at the level of the vertebral column at different regions - cervical, thoracic, lumbar-sacral.

Children in the first months of life have a more marked muscle tone than older children. Being in the womb, the fetuses every day grow and develop, the space inside getting smaller and smaller. At birth the newborn's muscles are tense. Certain muscle groups may be in hypertonia, this being a norm.

What is normal in newborns, at an older age may be a pathological sign. The muscle tone of a 2-year-old child should be about the same as in adults. But there are many intrauterine factors, which at birth can cause different conditions of the muscle tone.

There are some common muscle disorders like: decreased muscle tone - hypotonia, increased muscle tone - hypertonia, incorrect distribution of the muscle tone and muscle groups - muscle dystonia.

In muscular hypertonia, the child does not relax even after 30 minutes, having a restless sleep. He cries, his chin trembles and he vomits.

Hypertonia can be increased symmetrically or asymmetrically on one side of the body. This can be a sign of trauma at birth, meningitis or internal *hemorrhage*. In late treatment (not found) it can lead to serious posture deviations: walking, scoliosis, torticolis, it can even cause incurable cerebral palsy.

In the case of hypotonia, the situation is reverse, when the tone is less than normal, hands and feet are open, the hands being parallel to the body.

In the face-down position on the adult`s hand with the child`s head and limbs hanging down the child is quiet, but with bad eating habits.

The most common change of the mixed muscle tone is when it is raised in one muscle group and reduced in another, thus initial hypotonia leads to hypertonia. This condition is called muscular dystonia.

Thus, one part of the body may be larger than the other. This may influence the baby's motor functions, namely, the ability of rolling from the back on the belly only at 5-6 months, sitting down after 7 months, walking only after 12 months.

Muscle spasm leads to severe spasm of the bladder muscles with (hypertonia) increased intravesical pressure, distal ureter - Waldeyer, muscular contraction of the bladder neck, external sphincter in boys and distal (meatal) part in girls, which in turn leads to ureteral reflux with constant sectioning (fig. 5, 6, 7).

The bladder muscles also obstruct the intramural ureteral segment. The bladder spasm leads to high intravesical pressure and thus children do not stand the bladder catheter.

Radionuclide voiding cystourethrography greatly improves the diagnosis of the functional status of the bladder and urethra. Reduced irradiation allowed the repeated use of the method for treatment assessment.

In girls urethral muscles can also be spasmed causing voiding dysfunction. The size of the *uroflowgrams* waves depends on the disorder degree and the passage of the urine below the obstruction, assessing the passage of the laminar flow into the turbulent current that cannot be detected by other examination methods. The wider the suprastenotic urethra region, the more pronounced the flow of the turbulent fluid is.

In parallel with the parietal movement, in girls the urine brings the urethral flora from the distal urethra, which is colonized 100% with pathogenic microbes. It rises to the bladder, which often leads to recurrent infections, more often than in boys, where also the turbulent and parietal movement is present. But the posterior urethra is rarely infected and recurrences are rare (fig. 5, 6).

This is the way stasis forms in the ureter. Any stasis sooner or later becomes infected and if the cause is not removed the infection recurs despite any intensive treatment.

The ureteral dilatation depends not only on the refluxing force, but also on the degree of obstruction and the ureteral contents return into the bladder (fig. 2, 3, 8).

The diagnosis of muscle contracture is improved by:

1. Neurological examination, that often detects pathological neurological signs. Both the doctors and boys` parents notice that they frequently urinate with a strong jet up to the chin.
2. Ultrasound of the urinary tract. Ultrasound reveals the bladder with a double contour with thickened walls, clear borders, in the dorsal part of the bladder the ureters are dilated (fig.12).

3. Electromyography of the suprapubic muscles - are signs of hypertonia (fig. 15, 16).
4. Plain and radionuclide *voiding* cystouretrography, reflecting a bilateral refluxing megaureterhydronephrosis, more often asymmetrical one, a more severe one, the opposite side - less pronounced, can be a marked unilateral reflux, which after antireflux operation also appears on the opposite side (fig. 8, 13, 19).

Unilateral vesicoureteral reflux, which can serve as a valve, protecting the contralateral kidney, can be caused by intravesicular hyperpressure. In this way the reflux does not disappear after the surgical correction.

- Dynamic renal scintigraphy - the filtering function is identical in both kidneys likewise the voiding function, the left and right obstructive curves differ (fig. 14, 19, 20);
- Cystomanometry – a high intravesical pressure up to 375 with H_2O (norm 140-180 cv H_2O);
- Morphology of the vesicoureteral segment (fig. 9, 10).

At first an organic obstruction is determined. At surgery the resection of the morphologically confirmed stenosed segment is performed. But it is not clear why along with stenosis in most cases the reflux is found. Stenosis of the distal fibrous-muscle Waldeyer sheath with stronger muscles and the distal ureter is stenosed (fig. 3).

In order to evaluate the activity of the perineal muscles, the electromyography of the anal sphincter is performed, because it is considered that the perineal muscles of the anal sphincter, the urethra and the bladder neck have a common innervation.

In newborns with a marked reflux, there are serious changes in urodynamics caused generally by the muscle spasm and the spasm of selective muscles of the lower urinary tract of the bladder.

In general the muscle spasm leads to intravesical hypertonia (confirmed by cystomanometry), intramural ureter obstruction, the Waldeyer urethral muscle spasm, with obstructive curves revealed at dynamic scintigraphy (fig. 11). The spasm is triggered at the intrauterine stage and is detected at ultrasound. In newborns there are already signs of fibrosis of the spasmed segments and dilatation of the ureters, which is impossible to prevent. Morphologically, the connective tissue fibrosis of the stenosed segments is often found (fig. 9, 10). Thus, the distal segment of the fibrosed and intramural ureter with a constant sectioning with a clear intravesical pressure leads to *vesicoureteral* reflux, which also under pressure as a spray pushes urine into the ureter. But the ureter has no force to return the contents into the bladder and to go through the distal ureter stenosis; the bladder muscles spasm, increased intravesical pressure (fig. 11).

Thus, it is a hypertonic bladder without dysuria because there is a megaureter with bladder neck spasm and external urethral sphincter in boys and meatal spasm in girls.

Clinical case: Child J. 20 days, hospitalized with bilateral megaureterohydronephrosis. The child had food intolerance, signs of endointoxication, hypotrophy and vomiting. Ultrasound revealed the bladder with double contour, bilaterally dilated ureters. At MCUG - marked reflux gr.V on the left, on the right - the reflux is not found (fig. 13). The Foley catheter was inserted. Dynamic renal scintigraphy - the filtering function is diminished, the voiding function is decreased - S≥D.

Urea, creatinine – in norm. General blood and urine analysis - no deviations. Electromyography of suprapubic muscles revealed a marked excitation (fig.15).

There was found a very high intravesical pressure - 375mm H_2O (norm - approx. 140-180) (fig. 17). There were administered uroseptics and spasmolytics. After 2 weeks, the electromyography revealed an improved hypertonus of the suprapubic muscles. The cystomanometry revealed a high pressure - 350.

The patient's condition improved. The patient was active. The patient`s pelvis on the left increased from 13 to 22 cm and on 02.07.19 there was performed uretero-cystoneoanastomosis on the left. The distal stenosed segment was resected, the condition being severe, but with a gradual improvement. On the 7th day, a urinary fistula opened, and the general condition improved. On 17.07.19 the patient was discharged. Shortly after, the fistula disappeared.The ultrasound performed over 2 months found that the ureters were bilaterally dilated (practically like before the operation), there was not fever, and the urine analysis was normal.

In these patients, the intravesical pressure is very high, which leads to VUR through the intramural and distal ureter, with a constant sectioning as a spray, because at examination the ureters were full of contrast agent. The refluxing ureteral contents are not able to return.

If the urinary tract infection is associated and there are urination disorders, the treatment is indicated only after the spasm improvement (intravesical pressure).

It should not be excluded that with age the spasm and fibrosis improve and the nervous system maturation occurs. The urodynamic abnormalities in newborns and infants in modern reflux classification not only depend on the reflux strength, but also on the degree of obstruction and return into the ureterovesical segment and increased intravesical pressure.

Clinical case (5 years ago): The more advanced (pronounced) the reflux is, the more obvious the stasis signs are, the spasm (fibrosis) of the distal ureter protects the kidneys from high bladder pressure.

Thus, this is a hypertonic bladder marked by the muscle spasm of the muscles of the lower urinary tract - distal ureter (Waldeyer sheath), bladder, bladder neck,

urethra, which leads to serious urodynamic abnormalities of the entire urinary tract and requires a complex treatment: spasm removal, surgery, intravesical pressure regulation, and fight with the urinary tract infection. In all the disorders described above there are some fibrosis features, but after the administration of spasmolytics the spasm

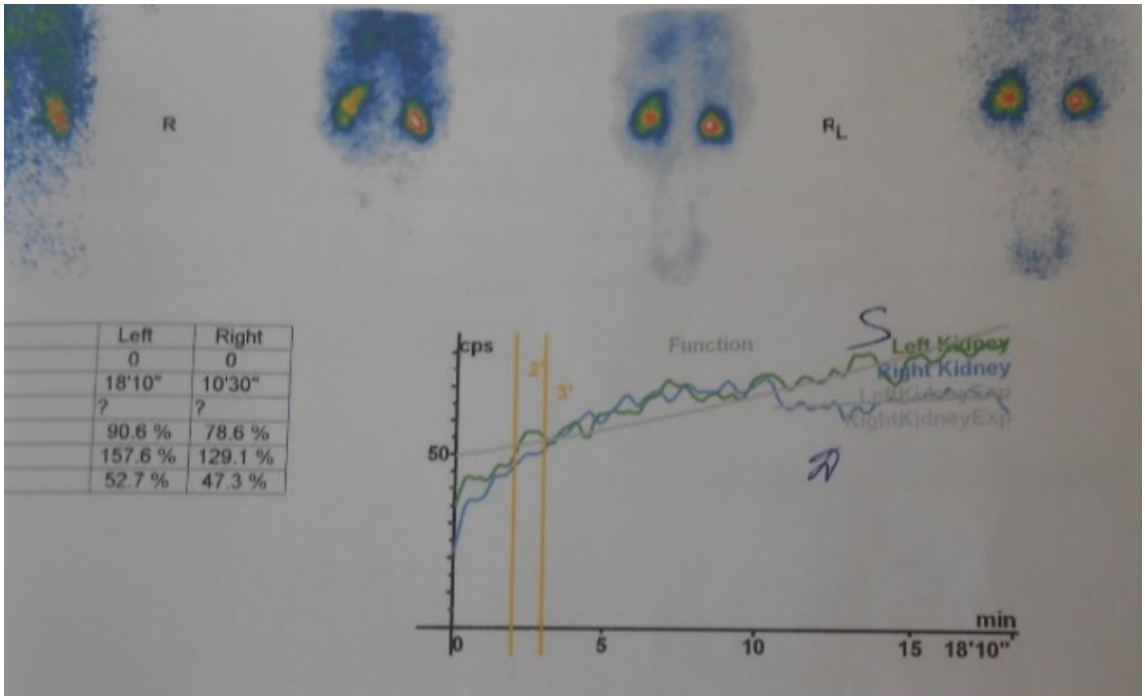

Fig.1. Dynamic renal scintigraphy, marked voiding *dysfunction* in a child with bilateral reflux.

Fig. 2. MCU. Bilateral refluxing megaureter hydronephrosis

Fig. 3. MCUG - VUR on the right with stenosis in the juxtavesical region

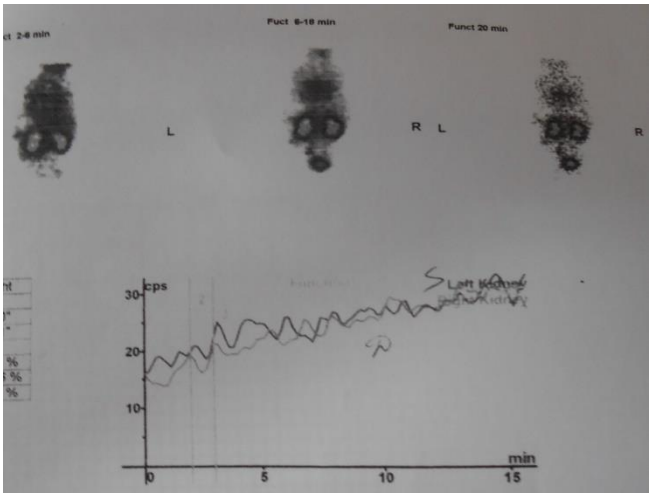

Fig.4. Dynamic renal scintigraphy: dilated ureters with peristaltic waves, obstructive emptying curves.

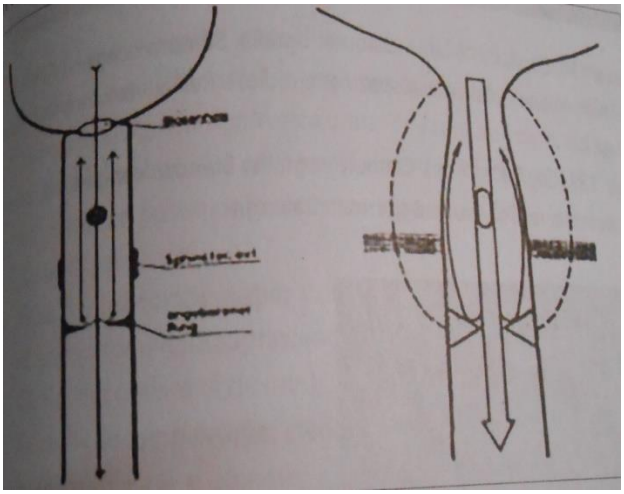

Fig.5. Parietal movement of urine in boys: a - without obstruction; b - obstruction of the posterior urethra

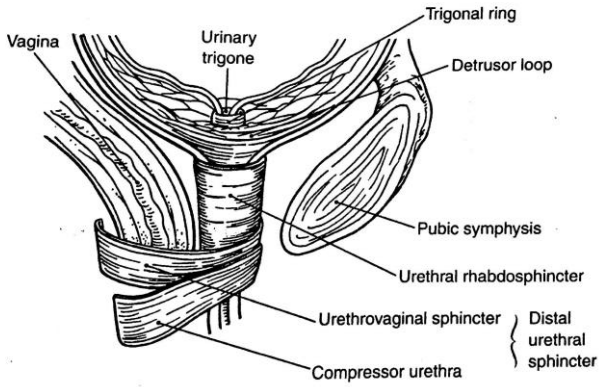

Fig.6. Schematic – urethral muscles in girls can also be spasmed, with voiding dysfunction (Plzak L., Staskin D., 2002)

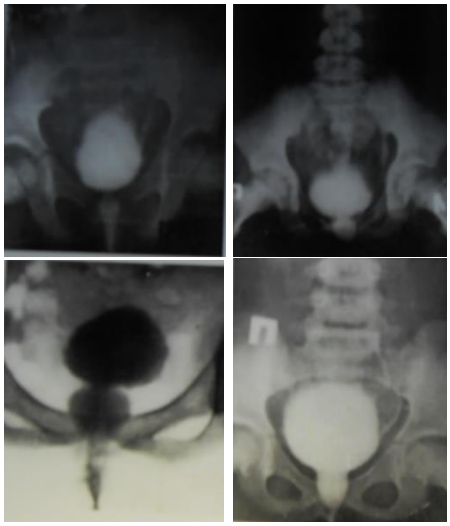

Fig.7 CUGM. Spasm of the distal muscles of the urethra in girls of various forms

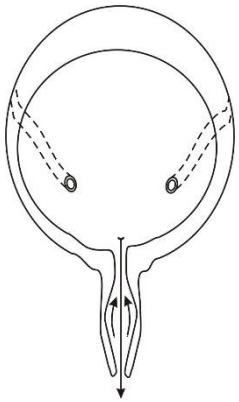

Fig. 8. Schematic - distal urethra spasm in girls with dilation of the proximal segment. Parietal movement of urine

Fig. 9. MCU. Refluxing megaureter-hydronephrosis on the left. Spasm of external sphincter

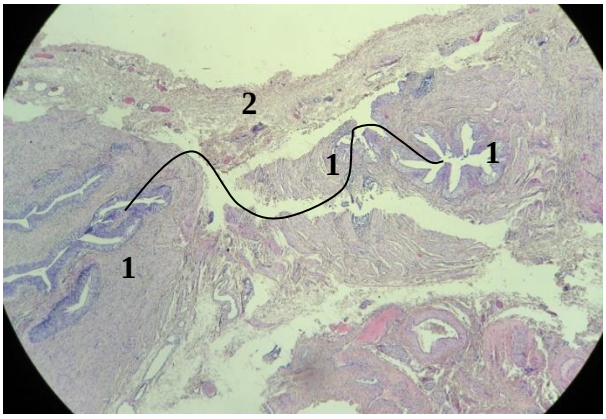

Fig. 10. Sinusoidal wavy path of the ureter adjacent to the urocyst implantation area: 1 - stenosed ureteral segment; 2 - peritoneum

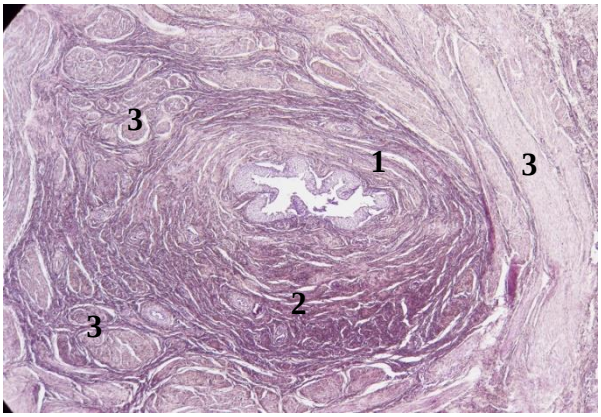

Fig. 11. Intramural ureteral segment: 1 - aplasia of ureteral musculature; 2 - abundant lax connective tissue with a sclerogenic reaction; 3 - musculature, muscle bundles of varying thickness due to aplasia and fibrosis. The lumen is preserved

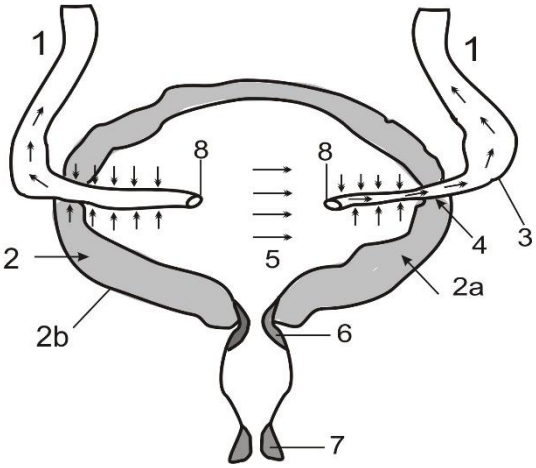

Fig.12 Schematic: etipathogenesis of reflux megaureter: 1-megaureter; 2 - spasmed bladder muscles; 2a - with stenosis in the uretero-bladder segment; 2b - without stenosis of the ureter; 3 - stenosis (spasm) of the distal ureter, Waldeyer area; 4 - obstruction of the ureter of the bladder muscles; 5 - obstruction of the increased intravesical pressure; 6 - spasm of the bladder neck; 7. - spasm of the sphincter external urethral; 8 - fibrosed ureter with constant section

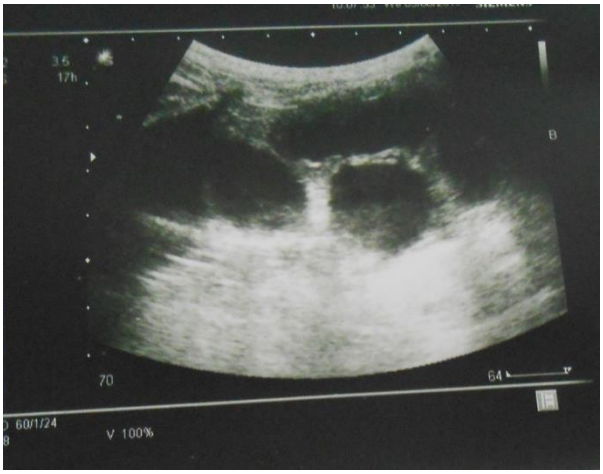

Fig. 13. Dilatation of ureters and renal cavities

Fig. 14. At MCU - gr.V reflux on the left, posterior urethral stenosis

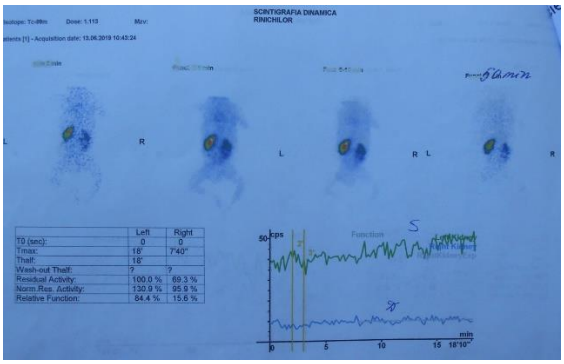

Fig. 15. Dynamic renal scintigraphy. On the left – significantly diminished voiding, decreased function on the right

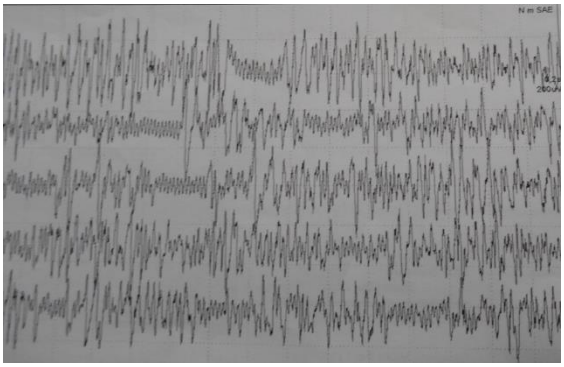

Fig. 16. Increased size and M-response amplitude frequencies. Suprapubic electromyography: before treatment

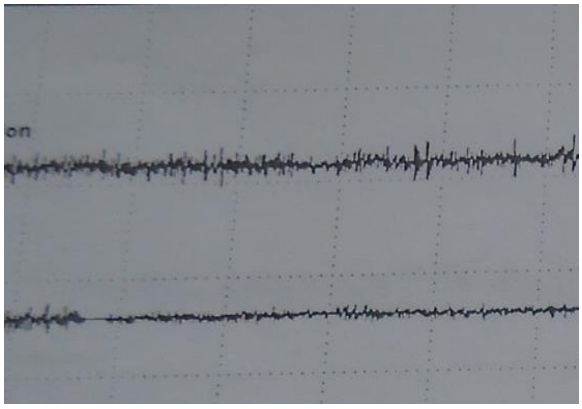

Fig. 17. 2 weeks after treatment

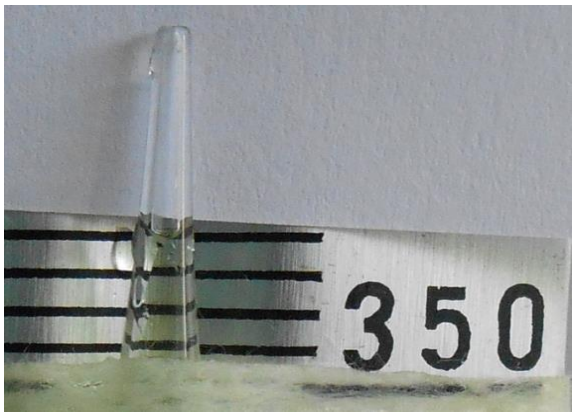

Fig. 18. Cystometry data

Fig. 19. The child during examination

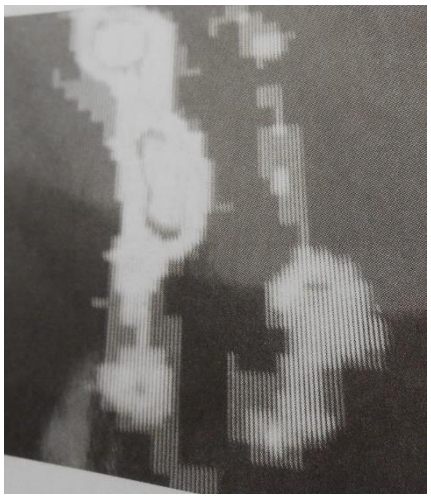

Fig. 20. CUG with radionuclides. Bilateral RVR, more marked on the right

diminishes. Their evolution must be studied more deeply. It is not excluded that they are reversible. Therefore it is necessary to study what is to be done to regulate their evolution.

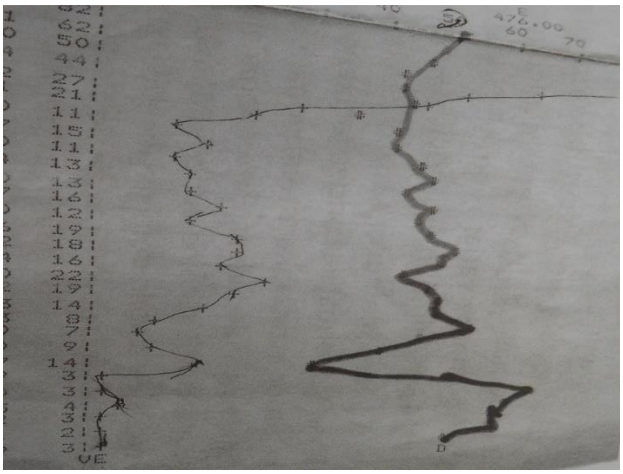

Fig. 21. The same child; curves collected from both ureters. On the right the ureteral voiding was severely diminished. On the left - complete voiding, but still a slow one

In fact, until now the attention has been drawn to the intramural ureter condition, trying to get it back to the normal condition. But our preventive studies account for a much more complicated and profound polyetiological condition in VUR. The treatment requires the restoration, the enlargement of the submucosal ureteral tract, that is prevalent today.

We have no experience in the treatment of this condition, but we recommend using a urinary catheter for a longer time, as well as fighting the infection and surgery. In stenosis the resection of the stenosed segment is performed. If stenosis is absent, the dilated ureter with signs of obstruction is also resected, because the intramural ureteral segment is stenosed and fibrosed by the bladder muscles and the intravesical pressure is increased.

The transurethral drainage through a catheter or via the suprapubic way contributes to an improved renal function. If the patient`s general condition does not allow radical treatment, a vesicostomy or nephrostomy is indicated. If the renal function does not improve which indicates a ureterovesical obstruction, the upper external derivation - pyelonephrostomy is indicated. Along with these methods, spasmolytics are administered, to eliminate, if possible, the spasm of the bladder muscles.

We recommend normalizing the intravesical pressure, preventing and combating the urinary tract infection in order to avoid irreversible complications of the upper urinary tract, reducing the number of chronic patients and patients requiring dialysis. Pediatric urologists, as well as adult urologists treat neurological symptoms, especially urination disorders, but they do not study the morphological and urodynamic abnormalities of the pelvic organs, especially due to the lack of appropriate equipment.

We recommend using frequently radionuclides in diagnosis, more often than urodynamic testing, which is noninvasive and informative. If the infection relapses the intravesical pressure is reduced by at least 50%, and intravesical anti-reflux operations should be carried out - the Politano–Leadbetter Cohen operation, in order to use the intravesical pressure and strengthen the antireflux mechanism. If we perform extravesical operations through the dilated open ureter**,** the intravesical pressure at each urination directly attacks the kidneys.

Treatment of the muscle spasm in newborns and infants is a rather serious problem. Only a few spasmolytic preparations are available – atropine and papaverine. The rest of drugs are recommended for adults.

The common efforts of physiotherapists and neurologists can help solve this issue.

Conclusions

1. The reflux megaureter develops intrauterine on the Waldeyer segment of muscle spasm, bladder muscles, bladder neck, external urethral sphincter in boys, and meatal in girls and substantially increased intravesical pressure of the open ureter with constant section.
2. The degree of the megaureter depends not only on the refluxing force but also on the degree of obstacle of the uretero-bladder segment when reintroducing the ureteral content.
3. Muscle spasm leads to disorders of the urodynamics with severe impairment of the upper urinary tract, renal parenchyma, in newborns already signs of renal failure with severe impairment of renal parenchyma - its deformation and fibrosis.
4. The treatment starts as early as the bladder, spasmolytics, physioprocedures, hydro massage and kinetotherapy, etc. to reduce the increased intravesical pressure after applying antireflux surgery, Cohen Leadbetter-Politano procedure, contemporary endoscopic methods to strengthen the antireflux mechanism.
5. After surgery, prolonged monitoring and treatment is recommended under the control of urine, cystometry, uroseptic, spasmolytic analysis because the intravesical pressure is difficult to normalize, it can only decrease.

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