W21: (Committee Activity) Neuromodulation and Neurostimulation in Children and Adolescents with Neurogenic and Pelvic Floor Dysfunctions (Open Session) PART A & PART B

Workshop Chair: Giovanni Mosiello, Italy
07 October 2015 14:00 – 18:00

Start	End	Topic	Speakers
		PART A	
08:00	08:35	Introduction	Giovanni Mosiello Mario Patricolo
08:35	08:50	When to consider neuromodulation in children and adolescents with neurogenic bladder/bowel dysfunctions and other complex pelvic floor dysfunctions?	Kwang Myung Kim
08:50	09:05	How to select patients for neuromodulation? Urodynamics and other diagnostic tests	Jian Guao Wen
09:05	09:25	TENS in children and adolescents	Kwang Myung Kim Jian Guao Wen
09:25	09:45	PTNS in children and adolescents	Enrico Finazzi Agrò
09:45	10:00	Sacral Neuromodulation in children and adolescents	Giovanni Mosiello
10:00	10:30	Break	None
10:30	10:40	"Hands on" on neuromodulation: Tips and tricks using video and discussion	All
10:40	10:50	Discussion	All
		PART B	
13:00	13:15	Disabilities affecting Continence and Bowel Function	Mario Patricolo
13:15	13:30	Addressing Continence in Children With Learning Disabilities	Mario Patricolo
13:30	13:50	Neuropathic Bladder and Bowel in Young Adults With Learning Disabilities	Giovanni Mosiello Jian Guao Wen
13:50	14:10	Learning Disabilities and Incontinence: The Power of the Mind	Jeffrey Lazarus
14:10	14:20	Case Scenario 1	Mario Patricolo
14:20	14:40	Case Scenario 2	Jeffrey Lazarus
14:40	14:45	Discussion	All
14:45	14:50	Take home Messages	Giovanni Mosiello

Aims of course/workshop

This workshop would be useful for paediatric urologist, urologist, colorectal surgeon, paediatrician, specialized nurses and physiotherapists, continence advisors and all people involved in the treatment in paediatrics and adolescents care of severe and/or intractable LUTS, constipation, incontinence and pelvic pain related to neurogenic, functional, and anatomical conditions. For this reason, neurological and complex pelvic floor conditions where neuromodulation could be used are evaluated. Criteria and diagnostic tools for patients' selection will be discussed. Evidence based medicine data, as well as personal tips and tricks in PTNS and sacral neuromodulation in children and adolescents, will be presented.

Learning Objectives

1. Recognize and define an evidence based medicine approach to LUTS in children with learning disabilities or with severe malformation and neurogenic bladder

2. Treat LUTS in children and young adults with learning disabilities

3. Know when to use Percutaneous tibial stimulation and sacral neuromodulation in the treatment of LUTS related to neurogenic anatomical and functional incontinence in pediatric and adolescent care and how to use correctly these techniques in order to improve results

Title: **BLADDER AND BOWEL DYSFUNCTIONS IN CHILDREN AND ADOLESCENTS : Adjournement on Neuromodulation and neurostimulation in Children and Adolescents with Neurogenic and Pelvic Floor Dysfunctions, and in the treatment of Urinary Incontinence and Bowel Management in Children and Young Adults With Learning Disabilities.**

Category: **Pediatrics**
Length : 240 min
Level: **Advanced**

Keywords: **Neuromodulation, Pediatric, Bladder Dysfunction**

Educational Value:

Different electrical nerve stimulation methods has been used through the years to treat lower urinary tract dysfunction in children and young adults : intravesical, transcutaneous, sacral spine and root, and tibial nerve stimulation in children with lower urinary tract dysfunction of nonneurogenic and neurogenic origin.Due to feasibility problems with placebo studies the majority of the studies were noncontrolled, some of them clinical trials on acute urodynamic changes during electrical stimulation or experimental research in animals. Only few publications on randomized trials exist. .Percutaneous tibial nerve stimulation is reliable and effective for nonneurogenic, refractory lower urinary tract dysfunction in children. Efficacy seems better in dysfunctional voiding than in overactive bladder cases. There is evidence that percutaneous tibial nerve stimulation is well tolerated .Sacral neuromodulation using implanted devices is promising but needs further clarification of its indications.Literature showed a favorable outcome for acquired versus congenital NBD. Subgroup analysis shows that the predictive value of the positive response of SNM depends on specific indications
Regarding the second part of the workshop our goal is for the attendees to leave the Workshop with increased knowledge on the management of bladder and bowel incontinence in children and young adults with learning disabilities

Introduction
Giovanni Mosiello
MD, FEAPU; FEBPS:

This workshop would like to define some pratical aspects in clinical treatment of LUTD in children and adolescentes regarding the use of neuromodulation. And how to approach patients with learning disabilities .
The topics are very actual because either the use of neuromodulation either how to approach patients with learning disabilities , need to be defined
For this reason the speaker , all involved in ICS Committees (Children and Young adults as well as Urodynamic) would like present their experience and discuss with the partecipants when, why and how to use neuromodulation in pediatric population and then in young adults in a transitional care point of view.
Different LUTD where neuromodulation could be used wil be presented: functional, neurogenic and anatomical causes. The different treatment options according to ICI recommendations will be discussed in idiophatic overactive bladder, intractable enuresis, non obstructive urinary retention, neurogenic bladder, bowel dysfunction, possible use in bladder exstrophy and valve bladder.
Then selection criteria will be then presented discussing the role of no invasive and invasive urodynamic tests, diaries, neurophysiological tests and all the criteria tha can be used in order to predict efficacy of the different teatment options.
Percutaneous Tibial Nerve Stimulation (PTNS) has been proposed for the treatment of overactive bladder syndrome (OAB), non-obstructive urinary retention (NOUR), neurogenic bladder, paediatric voiding dysfunction and chronic pelvic pain/painful bladder syndrome (CPP/PBS). Despite a number of publications produced the role of PTNS in urinary tract dysfunctions remains unclear. A systematic review of the papers on PTNS will be presented performed with the aim to better clarify potentialities and limits of this technique in pediatrices where PTNS has been demomnstrated safe, minimally painful and feasible in children and seems helpful for treating refractive nonneurogenic LUTS.Efficacy seems better in dysfunctional voiding than in overactive bladder cases. There is evidence that percutaneous tibial nerve stimulation should be part of the pediatric urology armamentarium when treating functional incontinence.
Since its first description in 1988 (Tanagho EA) a significant number of reports have been published on sacral neuromodulation (SNM) . In the last decade SNM gained widespread recognition for the treatment of incontinence in adults, and it was approved by the Food and Drug Administration for the use in urology in 1997. For NBD in a systematic review stated that there is evidence indicating that SNM may be effective in adults with NB, but it is still not possible to draw a definitive conclusion. Because the scant published experiences, the safety and effectiveness of SNM have not been established for patients 50 voided volume. The results of our own series

showed an overall success rate of 71.4, versus 70.4 in the literature studies. Considering different pathologies, incomplete spinal cord injury (SCI) presented the highest success rate; 100 in the literature and 75 in our own experience. The lowest rate was reported in complete SCI and myelomeningocele (0).
Tips and Tricks of PTNS and SNM will be presented using video and then discussed with partecipants, with the aim of familiarize all with these 2 techniques safe and effective too in different patient population, that for this reason must be carefully selected for a correct indications.

The diagnosis of incontinence in children and young adults with learning disabilities is difficult and frequently missed due to the peculiar limitations in communication typical of these patients and also to some misconception, such as that incontinence is a normal aspect of the disability itself. This profile, may lead to long term deterioration of an already affected quality of life, but equally important to risk of loss of renal function and intestinal competency. As a matter of fact detrusor sphincter dyssinergia, dysfunctional voiding and chronic obstinate constipation are responsible for severe complication, including end stage renal disease and recurring enterocolitis in patients with neurogenic and non neurogenic bladder/bowel, even without disabilities. Learning disabilities amplify the risk of missing the early stages of the conditions and of "getting to a final diagnosis" too late.
Children and young people with disabilities, including Down’s syndrome, often experience bladder and bowel dysfunction. A variety of comorbidities and other factors contribute to continence problems. If undetected and left untreated,these problems can lead to long-term bladder and intestinal damage. However, health professionals and families might attribute bladder and bowel dysfunction to the child’s disability and they might not receive a proper assessment or suitable treatment. Simple measures such as addressing fluid intake, ensuring regular toileting and prescribing appropriate medication can be effective. Children and young people with disabilities should enjoy the same access to mainstream continence services as their non-disabled peers.

Factors COntributing to bladder and bowel dysfunction in children and young adults with learning disabilities:
? Reduced dexterity and posture issues
? Renal failure
? Associated metabolic conditions such as Fanconi syndrome (which affects the proximal renal tubules of the kidneys leading to problems of reabsorption of essential elements including glucose, amino acids and bicarbonate)
? Psychological conditions such as depression or psychosis
? Short bowel syndrome
? Gastrostomy feeding

? Swallowing difficulties affecting fluid intake and diet
? Dietary intolerances
? A paradoxical or allergic reaction to essential medication (anticholinergics, alpha-blockers, laxatives)
? Forgetfulness regarding medication intake or deliberate avoidance

AllThe risk is that untreated bladder and bowel problems, including incontinence, will persist into adulthood. A transition plan should be put into place for those young people, with specific tailoring for their age and their disability.

Key Learning Points:
- Most common learning disabilities associated to urinary incontinence or bladder and bowel issues;
- comorbidities associated to urinary incontinence and bowel incontinence or obstipation;
- Specifically tailored integrated care pathways for different types of learning disabilities
- omnicomprehensive approach to bladder and bowel management, including patients' and relatives/carers participation
- transition steps from paediatric to adolescent age and from adolescent to adult age in the clnical and domestic environment
- expected levels of quality of life in different clnical scenarios.

When to consider neuromodulation in children and adolescent with neurogenic Bladder/Bowel dysfunction and other complex pelvic floor dysfunctions?

Kwang Myung Kim

There are many options to treat incontinence in child with neurogenic Bladder/Bowel dysfunction (NBBD), such as anticholinergics, sympathomimetics, antisympathetics, Botox intravesical injection, neuromodulation, augmentation cystoplasty, ractus fascial sling and Malone procedure etc. Among them Neuromodulation is one of the attractive treatment modality to improve urinary or stool incontinence.

Neuromodulation includes transcutaneous electrical nerve stimulation (TENS),[1, 2] percutaneous tibial nerve stimulation (PTNS)[3] and sacral neuromodulation with an implantable pulse generator,[4, 5] etc.[6]

Although Upper tract deterioration is most severe form of symptom in child with NB, incontinence also suffers them. Anticholinergics and intermittent catheterization are conventionally used to decrease detrusor overactivity and to increase bladder compliance in child NB.

Actually neuromodulation focuses on improving incontinence. Neuromodulation inhibits detrusor activity via centrally acting afferent pathways including increasing sympathetic tone and peripheral reflex pathway via pudendal afferent nerve stimulation.[7]
This mechanism is also effective in the treatment of stool incontinence in child NBBD.[8]

The incidence of side effect of anticholinergics is relatively high in children. Anticholinergics can make worse constipation in the patients with NB.

Furthermore there are few anticholinergic drugs to use in child with NB because most recently developed long-acting anticholinergics focused on adult. So patient's compliance to drug administration is one of difficult problems in child with NB.

Although Botox injection to child NB is thought to be another treatment modality, the effect is not sustained and repeated injection is needed.[9] We have to consider general anesthesia and financial problem before repeated injection of Botox.

There are few drugs to use for urethral sphincter control in child with NB and most recently used drugs act on autonomic nerve, such as sympathetic or sympatholytic drugs rather than directly on somatic nerve. Side effects of these drugs become gradually high at increasing dose.

Clean intermittent catheterization (CIC) is not well performed during adolescent stage. And CIC is bothersome to both parents and patients in young children. Neuromodulation can be applied in 5-year-old child with nonneurogenic overactive bladder (OAB) or neurogenic bladder.[3]

In conclusion, neuromodulation is considered in children and adolescent with neurogenic Bladder/Bowel dysfunction when the patient has 1) an age older than about 5 years 2) detrusor overactivity, 3) drug resistance and low compliance for drug intake 4) side effects of drugs, 5) low compliance for intermittent catheterization, 6) stool incontinence, 7) reluctance to receive Botox injection or definite operation such as bladder augmentation or rectal fascial sling in refractory cases 8) no severe sacral bone abnormality.

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How to select patients for neuromodulation?

Urodynamics and other diagnostic tests

JG Wen

Introduction

Electric neuromodulation, derives from clinic electric nerve stimulation, then developed into a new therapy recently by stimulating the nerve with low frequency pulse continuously, which excites or inhibits the neurol pathway and regulate the abnormal reflex, affectes intrinsic nerve reflex through the synaptic junction, thus improving the function of target organs. In urology, it includes sacral nerve stimulation（SNS）or sacral nerve modulation（SNM）, percutaneous tibial nerve stimulation（PTNS） and pudendal nerve stimulation（PNS）. Neuromodulation is a relatively new treatment that is used for multiple different lower urinary tract conditions although it has been extensively investigated for more than a century as an alternative treatment for LUTs [i]. However, only SNS and PTNS are currently approved by FDA for the treatment of urinary symptoms.[ii]

SNS is the most widely used techenic of neuromodulation which was approved by the U.S. FDA in 1997 for treatment of urge urinary incontinence, in 1999 for treatment of urinary urgency-frequency and nonobstructive urinary retention, and in 2011 for fecal incontinence. It has also been used to treat some other diseases. . In all cases, neuromodulation is not used as a first-line treatment but rather for the patients who are fail for the conservative treatments and are intend to have operation[iii].

Indications and technique

Ptients should be these who have undergone conservative treatments, for example, behavioral regulation or drugs, either fail or lead to adverse events. Neurostimulation techniques are mainly used in children as shown as follows: ①overactive bladder （OAB）, ②Non-obstructive urinary retention, ③interstitial cystitis, ④pelvic pain, ⑤neurogenic bladder caused by spinal cord injury.

Similar to adults, children are faced with various degrees of lower urinary tract dysfunction including incontinence, overactive bladder, and urinary retention and evenwith upper-tract deterioration. The underlying cause is unknown.Children often require management with intermittent catheterization and anticholinergics, but the treatment is not uniformly successful. It makes sense to consider neuromodulation before any irreversible reconstruction is considered [iv]. Over the years the technique of neuromodulation has become less invasive, more safe, reliable and effective, with the technical improvements. The re-operation and complication rates have decreased significantly. The clinical results have led to expanding indications because of positive effects in other symptoms. Use of SNS for neurogenic lower urinary dysfunction seen in multiple sclerosis has been reported.

Neuromodulation provides an attractive option for the patients mentioned above following failure of conventional therapies. Overactive bladder was by far the most common reason for neuromodulation. Failure to have relief of symptoms after a trial of behavioral therapy and anticholinergic medications is sufficient to consider offering patients neuromodulation therapy for OAB[v].Multiple neuroanatomical pathways have been described as targets for neuromodulation. The third sacral (S3) nerve root was the first to be described and remains the main access point used for neuromodulation treatment. In addition, studies on electronic stimulation of the tibial nerve and pudendal nerve have been positive. In the United States, SNS and PTNS have been approved by FDA for the treatment of urology diseases.

Exclusion criteria for neuromodulation have not been clearly defined. Locating the nerve in obese patient is technically challenging; likewise, skeleton deformity could present similar challenges. However, a recent retrospective study showed no difference in procedural success(defined as progression to stage II implant) between obese and non-obese patients[vi]. Older patients has been shown to be associated with lower cure rate[vii] and those with cognitive deficits might have difficulties with managing the device.

Currently, MRI of the abdomen or pelvis is contraindicated with neuromodulation owing to concerns regarding dislocation of the device, changes to the programme caused by the magnetic fields and heating of the metal electrodes[viii]. The findings of recent studies[ix]. suggest that MRI can be safely performed outside of the pelvis. Pregnant women should not undergo neuromodulation treatment owing to the theoretical risk of fetal loss or preterm labour. If pregnancy is achieved after a device has been placed, it should be turned off during pregnancy and restarted after delivery[x].

Urodynamic study used in selecting the patients

All the patients must be assessed with a thorough medical history, physical examination, including genitalia, anus, rectum and neurological examination, accurate records 3-7d voiding diary, urodynamics and accept the neurophysiological measurement, to confirm the diagnosis and determine whether to accept the preliminary suitable candidates for SNS therapy. Video urodynamics have more advantages than conventional urodynamics in choosing whether to accept the SNS. In addition, urinalysis, urine culture, urinary tract ultrasonography, cystoscopy urethra and bladder wash cytology examination should be taken before experience treatment to rule out other diseases which need to accept different treatment. Low compliance bladder, urinary tract infections, urinary tract malignancies and patients with neurological diseases should not receive SNS treatment.

The follow-up are taken at two weeks, 3 month, 6 month after SNM, then once every six months. Each follow-up should cover physical, voiding diary, programmed stimulation parameters detected and / or adjustment, sacral X-ray radiographs, while concerned about the psychological state of the patient, if necessary, psychological assessment and intervention.

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TENS in treatment of voiding dysfunction in children and adolescents

JG Wen and Kweung

Voiding dysfunction is often challenging to treat and have a significant adverse effect on quality of life in children and adolescents. Until the clinic application of electrical stimulation techniques, refractory cases were offered long-term catheterization or surgical management. A variety of electrical nerve stimulation methods has been used for many years to treat lower urinary tract dysfunction. One of which is transcutaneous electrical nerve stimulation (TENS) that is used in treatment of bladder dysfunction in children and adolescent effectively[x][x][x]. TENS is available as an alternative that is less invasive for treatment of voiding dysfunction (refractory OAB and non-obstructive urinary retention).

Present paper will introduce the definition, technique applicability, indications and usefulness in children and adolescents with bladder dysfunction.

Definition

TENS is the use of electric current produced by a device to stimulate the nerves for therapeutic purposes. TENS, by definition, covers the complete range of transcutaneously applied currents used for nerve excitation although the term is often used with a more restrictive intent, namely to describe the kind of pulses produced by portable stimulators used to treat pain.

History

TENS has been used in clinics since 1970, and mainly used for treatment of chronic pain. TENS in urology was first attempted suprapubically for pain management in interstitial cystitis in 1994[x]. Then several studies compared TENS to medical treatment in adults with idiopathic OAB and showed improvement in urgency as well as a reduced number of incontinence episodes with increased bladder capacity calculated as voided volume[x][x].In 2001, TENS was used for treatment of bladder dysfunction in children and adolescents with idiopathic OAB[4,5]. Hoebeke et al[4] and Bower et al[5] published their studies in 2001 on idiopathic OAB in children treated with daily TENS for 1 month with electrodes placed over the S3 foramen[4], or with sacral and suprapubic stimulation[5]. The 2 studies[4,5] showed improvement in urgency as well as a reduced number of incontinence episodes with increased functional bladder capacity. Recently, TENS is used widely in children and adolescents with lower urinary tract dysfunction including OAB and several randomized controlled[x][x] trials demonstrate that TENS was an effective and safe method to treat OAB in children and adolescents.

Methods

Generally TENS is applied at high frequency (>50Hz) with an intensity below motor contraction (sensory intensity) or low frequency (<10Hz) with an intensity that produces motor contraction. While the use of TENS has proved effective in clinical studies, there is controversy over which conditions the device should be used to treat. The unit is usually connected to the skin using two or more electrodes. A typical battery-operated TENS unit is able to modulate pulse width, frequency and intensity. In the study of Tellenbach et al[x], TENS was performed at home with Alpha 4 Conti (Danmeter A/S, 5000 Odense C, Danmark) stimulation device applying Periform + vaginal electrodes in girls and PEN2 penile electrodes in boys. Bipolar stimulation with 8 Hz and 400 us at sensory threshold level was used for 20 min twice a day.

Indications

1. Overactive bladder syndrome

TENS is an established treatment for OAB in children and adolescents. In addation, TENS may be also a valuable option in adults.

2. Non-obstructive urinary retention

TENS is a good treatment option for children and adolescents with non-obstructive urinary retention[x].

3. Pain

TENS devices available to the domestic market are used as a non-invasive nerve stimulation intended to reduce both acute and chronic pain.

4. Constipation

The efficacy of TENS on children with constipation has been evaluated in some studies[x][x][x]. As constipation is closely linked with LUTD due to the anatomical and nervous relationship between the urinary and gastrointestinal tracts, it is not suprising that LUTD is associated with the retention of feces. TENS is a good treatment option for constipated children with LUTD[x].

5. Others

TENS was used also for neurogenic dysfunction with myelomeningocele without convincing results. Controlled studies are insufficient.

Treatment response and follow up

The duration of treatment and the number of sessions a week were variable among the studies [14,15]. In the study of Tellenbach et al[x],Transcutaneous electrical nerve stimulation was successful following 12 weeks of treatment in 21 (50 %) of the 42 patients. The positive TENS effect was sustained during a mean follow-up of 21 months (SD ± 22; range, 6–83 months) in 18 (86 %) of the 21 patients. At the last known follow-up, 4 of the successfully treated patients were still under TENS; the 14 remaining had a sustained effect without treatment. The results of the randomized controlled trial undertaken by Hagstroem et al[x].23 on patients with refractory OAB showed 61% in the test group had a partial response to the treatment compared to 17% in the control group ($P < 0.05$). In this study, there was no increase in the maximum and average voided volumes resulting from TENS.

Contraindication

1.TENS used across an artificial cardiac pacemaker may cause interference and failure of the implanted device. Serious accidents have been recorded in cases when this principle was not observed.

2.The use of TENS is likely to be less effective on areas of numb skin/decreased sensation due to nerve damage. It may also cause skin irritation due to the inability to feel currents until they are too high.

3.There's an unknown level of risk when placing electrodes over an infection, but cross contamination with the electrodes themselves is of greater concern.

Discussion

Transcutaneous electrical nerve stimulation (TENS) is a non-invasive method which requires surface electrode for neuromodulation in child with neurogenic bladder/bowel dysfunction (NBBD). Child needs not have any horror of needle penetration which is required in percutaneous tibial nerve stimulation (PTNS) and sacral neuromodulation with an implantable pulse generator.

Actually the study of TENS in child with nonneurogenic overactive bladder (OAB) was firstly published in 2001.[1, 2]
Parasacral TENS becomes popular method but several other spots have been studied, such as suprapubic areas.[2]

Barroso et al (2013)[3] reported their method of parasacral TENS in children with nonneurogenic OAB. Parasacral TENS was performed at clinic using 2 superficial 3.5 cm electrodes placed on each side of S3 and S2. Electrical current was produced by a generator.
The procedure consisted of 20 sessions of parasacral TENS. A frequency of 10 Hz was used with a 700 us pulse generator. The current intensity was increased to the maximum level tolerated by the child. Parasacral TENS was performed 3 times weekly in 20-minute sessions.

Veiga et al (2013)[4] reported the satisfactory results of parasacral TENS on constipation in children with lower urinary tract disease.

Although the results of TENS have shown about 60~76%[1-3, 5] improvement of symptom in child with nonneurogenic OAB, the success rate was not convincing in child with NB.

Balcom et al (1997)[6] studied home therapeutic TENS for urinary and bowel incontinence in 29 children with meningomyelocele. In 9 boys and 2 girls follow-up period was more than 9 months.
Mean actual bladder capacity increased significantly from 133 to 196 ml. No significant change was observed in urethral pressure profile. A subjective improvement in the sensation of pelvic fullness was also observed.

Neuromodulation inhibits detrusor activity via centrally acting afferent pathways including increasing sympathetic tone, and pudendal afferent input which can turn off supraspinally mediated hyperactive voiding by blocking ascending sensory pathway inputs.[7]
Considering mechanism of neuromodulation, we can imagine that intact neural pathway is needed for TENS to be more effective treatment.

In 2009, Cirovic et al[8] reported on TENS treatment in 49 children with occult spinal dysraphism. They divided patients into two groups. The first group received drug therapy and the second group received drug therapy with parasacral TENS.
Follow-up evaluation was done at 3, 6 and 12 months. They evaluated 4 symptoms: diurnal incontinence, enuresis, urgency and frequency and 4 urodynamic

parameters: bladder capacity, detrusor overactivity, residual urine and detrusor sphincter dyssynergia.
They found statistical significance of improvement in all evaluated parameters and resolution of symptoms (predominantly enuresis, urgency) in the group of combined therapy.

In 2010, Kajbafzadeh et al[9] reported on functional electrical stimulation in child with meningomyelocele. Two rectangular self-adhesive (2.5 × 2.5 cm) electrodes were used. Positive electrode was placed on the skin above the pubic symphysis, and the negative one was placed on the skin under urethra.
Fifteen courses of stimulation for 15 minutes 3 times per week were performed with low frequency (40 Hz) electrical current. Mean age was 5.04 (range 3-11) years. After 3 months, 9 children had improvement on urinary incontinence score, while three children had no improvement. Median detrusor leak point pressure (DLPP) and Mean bladder capacity were significantly increased.

In 2014, the same group[10] also reported on randomized trial in 30 children with meningomyelocele with the same treatment method.
After 6 months DLPP increased significantly in treatment group and daily incontinence score also improved significantly in the treatment group compared with sham stimulation group.

In conclusion, transcutaneous electrical nerve stimulation in child with NBBD was not studied by many investigators, so there were very few reports. And the study population, technical methods, evaluation parameters were not clearly defined and diverse. More randomized controlled studies are needed to evaluate therapeutic effects of TENS in child with neurogenic bladder/bowel dysfunction.

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Percutaneous Tibial Nerve Stimulation (PTNS) efficacy in the treatment of lower urinary tract dysfunctions in adults and children (an extract from: Gaziev G et al: BMC Urol 2013, 13:61).

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BACKGROUND

Percutaneous Tibial Nerve Stimulation (PTNS) is a lower urinary tract neuromodulation technique performed by percutaneous electrical stimulation of the posterior tibial nerve. This technique was described by Stoller in the late 1990s for the treatment of overactive bladder syndrome [1]. The needle insertion point, situated 4-5 cm cephalad to the medial malleolus, has previously been acknowledged as a neural access point for the regulation of bladder and pelvic floor function. Furthermore, experiments on animals demonstrated that the electrical stimulation of the hind leg produces detrusor inhibition [2]. Basing his research on these concepts, McGuire [3] showed that the transcutaneous electric stimulation of the posterior tibial nerve can suppress neurogenic detrusor overactivity

Description of the technique

The technique consists of stimulating the nerve by means of a 34 gauge needle electrode inserted 4-5 cm cephalad to the medial malleolus. Once the current is applied, the flexion of the big toe or the movement of the other toes confirms the correct positioning of the needle electrode. The electric current is a continuous, square wave form with a duration of 200 µs and a frequency of 20 Hz. The current intensity is determined by the highest level tolerated by the patient. In figure 2 the equipment (Urgent® PC, Uroplasty, Minnetonka, MN, USA) needed for the stimulation is represented. The stimulation sessions last for 30 minutes and are performed once a week for 10-12 weeks in the majority of published papers. In a report published by Finazzi Agrò et al [4], the possibility of a more frequent stimulation was analysed: stimulation performed 3 times a week obtained the same results obtained as a weekly stimulation protocol. The advantage of more frequent sessions is to obtain effects in 4 weeks instead of 12: results seemed to be dependent upon the number of stimulations performed and not the time elapsed from the beginning of the stimulation program [4]. In a recent study [5], a protocol of weekly PTNS sessions performed for 6 weeks was evaluated in women with overactive bladder syndrome. The Authors found that this shortened protocol obtained a positive response in 69,7% of 43 women.

Mechanisms of action

To date despite of its great clinical use, PTNS mechanism of action still remains unclear even though in the last years several studies have tried to better clarify it.

Some papers have shown that an effect of detrusor inhibition can be found after hind leg or pudendal electric stimulation in animal models [2, 6]. In two very recent studies [7, 8] Tai and co-workers have found that irritation induced bladder overactivity is suppressed by tibial nerve stimulation in cats. A 30 minute stimulation at both low (5 Hz) and high (30 Hz) frequencies was able to induce prolonged poststimulation inhibition of bladder activity, which lasted for more than 2 h and significantly increased bladder capacity.

Danisman [9] found that after PTNS the mast cells count in the bladder of female rats diminished.

Another study, as described by Chang and colleagues [10], show that PTNS could produce effects on the (sacral) spinal cordby reducting C-fos expression (a marker of neuronal metabolic activity), in rat sacral spinal cord, after electrical stimulation of the hind leg.

An effect on supraspinal centers, has also been demonstrated in humans in a paper published by Finazzi Agro [11]. The Authors found a significant increase in amplitude of long latency somatosensory evoked potentials (LL-SSEP) recorded 24 hours after the end of a 12 session PTNS program. This finding could reflect a modification in elaboration mechanisms of sensory stimuli and it suggests a possible reorganization of cortical excitability after PTNS.

In conclusion, data available do not permit to draw definitive conclusions about PTNS mechanisms and sites of action; the results of this treatment can be due to effects on different areas of the central nervous system, but also to a peripheral effect on the target organ.

Results in overactive bladder syndrome

Several studies have been published evaluating the effects of PTNS on OAB [14-18]. According to these studies, the overall percentage of patients classified as "successfully treated" was 54.5-79.5%. Of note, the definition of "success" differs among studies from the use of urodynamic data to clinical parameters and quality of life measures. In spite of these differences, the reported success rates are of clinical interest, especially because many were obtained from a population of patients who were already non responsive to conventional therapies. Improvements are reported not only in symptoms, but also in urodynamic observations. Klingler [14] reported a reduction of detrusor overactivity and Vandoninck showed an increase of the cystometric capacity and of the threshold of appearance of involuntary detrusor contractions [18].

Randomized controlled trials on OAB

More recently, some randomized controlled studies on PTNS as treatment of OAB have been published. Peters et al [19] provided the results of a randomized controlled study comparing PTNS to tolterodine 4 mg extended release. The subjects' global response assessments of overactive bladder symptoms was improved from baseline in a significantly higher percentage of patients in the PTNS arm compared to the tolterodine arm (79.5% reporting cure or improvement vs. 54.8%, p = 0.01). Objective measures (reductions in urinary frequency, incontinence episodes, urge severity and night-time voids; improvement in voided volume) improved similarly in both groups. The Authors state that PTNS is safe and offers improvements of OAB symptoms, with objective effectiveness comparable to pharmacotherapy.

After first developing a validated sham for PTNS [20], Peters randomized a total of 220 adults with OAB to PTNS or sham therapy [21]. PTNS subjects achieved statistically significant improvement in bladder symptoms with 54.5% reporting moderately or markedly improved responses compared to 20.9% of sham subjects from baseline (p<0.001). According to Authors, PTNS therapy is safe and effective in treating OAB and superior to a placebo.

More recently, Finazzi Agrò [22] provided a prospective double blind, placebo controlled study aimed to investigate the possible placebo effects of PTNS on detrusor overactivity incontinence. Patients were randomly assigned either to PTNS or to placebo group. Patients showing a reduction >50% of urge incontinence episodes were considered "responders". A statistically significant difference between responders' rates was found (71% in PTNS group vs 0% in placebo group, p<0.0001). Improvement in the number of incontinence episodes, number of voids, voided volume and Incontinence quality of life (I-QoL) score were statistically significant in the PTNS group but not in placebo group. The authors concluded that the relevance of a placebo effect was negligible in this patients' population.

Results in non-obstructive urinary retention

PTNS has been used also in the treatment of non-obstructive urinary retention (NOUR) and the experience in this field is limited to few published papers. According to these papers, the percentage of patients successfully treated is good, varying from 41 to 100%, according to the parameters chosen to classify "success" [14, 23, 24]. In a study published by Vandoninck [23], the primary outcome measure was a reduction of the total catheterized volume per 24hours. Using a reduction of >50%, the percentage of responders was 41%; using a reduction rate of >25%, the percentage of responders was 67%.

According to another paper from the same authors [24], an improvement of the urodynamic parameters of the voiding phase (maximum flow, detrusor pressure at maximum flow, post-void residual urine) was also observed.

Van der Pal [25] showed that PTNS has an effect on the QoL of all patients investigated and a reduction of at least two pads/day recorded in the bladder diary.

Results in children

PTNS seems to be effective in the treatment of non-neurogenic lower urinary tract dysfunction of children: 60-80% of children with OAB and 43-71% of children with urinary retention showed a significant improvement [26-28]. De Gennaro [27] found that PTNS is generally well accepted by children, with low scores of a visual analog scale for pain, that further decreased during the treatment. Efficacy at 2 year follow up was maintained [28].

Results in children are reported in Table 1: no randomized controlled trial is available for PTNS as treatment for dysfunctional voiding/OAB in children; only prospective non randomized trials are available (level of evidence 2-3).

Authors	years	Control group	PNT			RCT	Methods	Level	Results	Female (%)	Mean age	Multicenter
			n	positive	%							
Hoebeke P	2002	N/A	31	27	87	N	Clinical and Urodynamic findings	2-3	Clinical and shape of the uroflowmetry curve	48	11,7	N
De Gennaro M	2004	N/A	10	8	80	N		2-3	Clinical and Urodynamic findings	60	9	N
De Gennaro M	2004	N/A	7	5	71	N		2-3	Clinical and Urodynamic findings	57	12	N
Capitanucci ML	2009	N/A	14	12	86	N	Clinical and Urodynamic findings	2-3	Clinical findings	NS	NS	N
Capitanucci ML	2009	N/A	14	14	100	N		2-3	Clinical findings	NS	NS	N

Table 1. Efficacy of PTNS use in children

Complications

No major complications are reported in the literature, following PTNS treatment. Only mild to moderate pain in the site of the puncture was reported by some authors; the majority of patients, with the inclusion of children, seem to tolerate perfectly the positioning of the needle and the subsequent stimulation.

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Sacral Neuromodulation

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Introduction

The control of lower urinary tract is a result of a complex interaction between peripheral and central nervous system . Any conditions impairing one of these may affect this control resulting in a Neurogenic bladder dysfunctions (NBD) with a negative impact in continence and patient's Quality of life , with an adverse effect on the upper urinary tract, potentially causing renal dysfunction (1).

The causes and presentation of NBD in children are different from adult, because in pediatrics these are more frequently caused by congenital problems as spina bifida, sacral agenesis and occult spinal dysraphism with or without tethered cord, while other causes as tumor or traumatic injury are less frequent.(2) In children as in adults the timing of intervention is important 3) and today clean Intermittent Catheterization (CIC) (if needed) with anticholinergics is commonly considered the mainstay for the treatment of NBD (4)
When the standard treatment has failed , other interventions have to be considered such as botulinum toxin or surgery, with a general agreement between pediatric urologists that , non-surgical interventions or mini-invasive treatment should be promoted before undertaking major surgery (5)
Sacral neuromodulation (SNM) is an established and reversible mini-invasive surgical treatment of lower urinary tract dysfunction (LUTD), such as non-obstructive urinary retention, urgency-frequency, and urge incontinence and it was approved by Food and Drug Administration for the use in urology in 1997. Since its first description in 1988 (6) a significant number of reports have been published on SNM in adults, but there is still a lack of studies describing sacral neuromodulation in patients with neurogenic bladder (1), showing a positive response in patients with an incomplete spinal cord injury.(7)In the pediatric population data are even more sparse.(,8,9,).and the safety and effectiveness of SNM have not been established for patients <18 years of age (10) because the scant published experiences (11)
We have started to use SNM in children with NBD in 2008 with discarding results and for this reason we have decided to compare our experience with other published studies with the aim to search and define criteria to optimize indications for SNM in children and young adults with NBD

Material and methods

According to our goal in order to obtain a larger population for a better insight in selection of patients for SNM in children/young adults with NBD, we compared the results of our own experience (group A) with the results of different studies found in literature (group B), using the same clinical criteria.

The inclusion criteria were: a maximum age of 21-years, NBD related to a well defined neurologic lesions, Exclusion criteria were: sacral agenesis, mental disabilities, upper urinary tract dilation or renal failure.

The clinical response, defining responders from non-responders at test phase and follow up, was evaluated based on patient and caregivers satisfaction and one or more of the following criteria: <50% incontinence episodes, <50% post voiding residual, <50% of necessity for CIC, >50% voided volume or presence of bladder sensation

Group A

All patients enrolled in the study presented NBD related to a well defined and stable neurological disease, , with an incomplete or response/side effects to the conventional therapy (CIC and anticholinergic drugs) and to botulinum toxin injections. NBD was treated with a mixed bladder emptying regime (spontaneous and CIC), and motivated patients and families. All selected patients were treated after a written informed consent was signed , according to the treatment regimen approved by our local scientific committee.

Patients were evaluated with an urodynamic examination, a pad test, voiding diary, a questionnaire on quality of life, psychological evaluation, neurophysiological tests and neurological evaluation on the ASIA impairment scale. The neurophysiologic tests (somatosensory evoked potentials).and the ASIA scale were used in order to determine preoperatively on which side of the body (left or right) the implant theoretically has the biggest chance of success , considering for this the less damaged side and then to choose this side for the the lead S3 implant and to evoke response to modulation.

We used the two stage tined lead placement technique (12). All patients were operated under local anaesthesia by the same surgeon (GM). In the first stage the quadripolar tined lead (mod 3889 Medtronic, Minneapolis, USA) was implanted in S3 foramina and an external neurostimulator device ,screener (mod 3625 Medtronic, Minneapolis USA) was connected by temporary extender leads.

The correct position in the S3 foramen and the depth were defined with the help of biplanar X-ray, The patient response was assessed by stimulation with an external pulse generator; once positive anal contraction and plantar flexion of the great toe was evoked

.In all patients a double tunneling of the electrode was performed in order to prevent the risk of superficial skin infection, erosion and dislocation. .

The external pulse generator was usually activated 3-24 hours after implantation: pulse duration 210 milliseconds, amplitude ranged 1-9V, frequency 10-20Hz. Usually patients were discharged home after 24 hours, depending on general status and postoperative pain level. The test-phase ranged from 15 days up to 3 months. Antibiotics were given for 24h intravenous and were continued after discharge per os (cefalosporine or quinolones) for ten days The patients who successfully passed the test phase and who met the requirements proceeded to the implant phase of Interstim II Neurostimulator (3058 Model Medtronic, Minneapolis USA) Only patients with a minimum 24 months follow-up were considered

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Group B

We systematically searched the PubMed, EMBASE and Cochrane databases (Appendix A). Language restrictions were applied to other languages than English. No date restrictions were applied. The last search was performed on December 2014. We hand-searched the reference list of all included studies and any relevant review articles.
Abstracts of all identified studies were independently reviewed by two authors (IJ and GM), and any study reporting on SNM for the treatment of neurogenic bladder in pediatrics was reviewed in full text. (Adult studies were reviewed if they reported on children as well if they were well described). We aimed to include any original SNM study that reported efficacy and/or safety data on tested and/or permanently implanted patients suffering from NBD. Non original articles, studies not published as full-text articles, and those including adults were excluded.

The variables assessed included year of publication, level of evidence, study type, number of patients, gender, age, (duration of the underlying neurologic disease), success rate (total, according to the neurologic disease/injury causing neurogenic bladder, according to the type of LUTD) of test phase and permanent SNM, duration of test phase, length of follow-up, adverse event (total, type of adverse event), and surgical intervention (total, type of surgical intervention) of test phase and permanent SNM. We have used in this group the same criteria of group A , in order to define responders and not-responders.

Results

According to our research methods we identified 71 patients aged 5-21 years , mean age was 14.3 years with NBD who were treated with SNM. We evaluated the results using a subgroup analysis comparing congenital with acquired NBD.

Group A)

About 21 patients with NBD were implanted , only 14 patients with a mean age of 16.1 year (range 10-21) were considered (2 were drop out after first stage and 5 with a follow-up lesser than 24 months). There were 10 boys and 4 girls of whom 6 had a congenital disorder and 8 had an acquired NBD.

The implant was always performed on the same side which was identified preoperatively during preliminary testing. No post-operative complications were observed in all

The average time of the intervention was 53 minutes for the first operation, and 40 minutes for the second one. All implants are in place and functioned well at last control. The clinical results are shown in table 1.

According to the defined parameters they were divided considering responders and non responders. Patients were considered responders if: they were satisfied and had one or more of the following criteria: <50% incontinence episodes, <50% post voiding residual, <50% of necessity for CIC, >50% voided volume.

Pt no.	Pathology	Con/Acq	Age	Responder/Non-responder
1	Teratoma	A	14	R
2	Iatrogenic	A	17	R
3	Ischemia	A	15	R
4	OSD	C	13	R
5	OSD	C	20	R
6	Transverse Myelitis	A	15	R
7	OSD	C	20	N
8	OSD	C	16	R
9	OSD	C	19	N
10	OSD	C	11	R
11	Neuroblastoma	A	21	R

12	SCI	A	13	R
13	Teratoma	A	10	N
14	OSD	C	21	N

Group B

Our research permit to identify 106 papers: 99 papers on Pubmed, 1 in Cochrane and 6 in Embase

49 articles were excluded because in other language than English, or too old (before 1981)

34 Duplicates were removed and 48 hits were Screened on abstract. About these

40 articles were excluded :because the topics were Intravescical electric stimulation, transurethral electric bladder stimulation, or Studies do not include children, Studies not evaluating the effect of sacral neuromodulation, or No NBD have been treated

After screening : 3 eligible pediatric studies and 5 adult studies were identified. A total of 57 patients (mean age 13.9 yr, range 5-21) were extracted from the articles because Two of the pediatric studies included patients with non-NBD and from the adult studies, we used only the data of patients up to 21-year-olds. We used only the information of patients who completed the trial period (for example Haddad et al, inserted 33 patients of which 24 completed the trial period then we used only the 24 patients who completed the trial).

References	**Year of publication**	**Study type**	**Country of study**	**No. of patients**	**Completed The study**	**Mean age, yr**
Guys et al[(4)]	2004	1	France	21	21	11.9
Haddad M et al [(2)]	2010	1	France	33	24	12.22
Luitzen-Albert Groen et al [(5)]	2012	2	Belgium	5	5	-
K-D Sievert et al	2010	1	Germany	1	1	19
B. Schurch et al	2002	3	Switzerland	2	2	17.5
M. Ishigooka et al	1998	1	Japan	1	1	15

M. Hohenfellner et al	2001	1	Germany	2	2	19.5
MS. Wosnitzer et al		3	Colombia	1	1	20

Study type (1=prospective cohort study, 2=retrospective case series, 3=case report)
(RCS: retrospective case series; P: permanent sacral neuromodulation; T= test phase; PCS= prospective cohort study; NR= not reported; CR: case report)

Overall results

References	**Total**	**Acquired complete lesion**	**Acquired incomplete lesions**	**Congenital**	**Success acquired complete**	**Success acquired incomplete**	**Success congenita l**	**Overall success**
Guys et al[4]	21		6	15	NA	NA	NA	10/21
Haddad M et al [2]	24		6	18	NA	NA	NA	18/24
Luitzen-Albert Groen et al [5]	5	0	2	3	-	2	0	2/5
K-D Sievert et al	1	1	-	-	0	-	-	0/1
B. Schurch et al	2	2	-	-	0	-	-	0/2
M. Ishigooka et al	1	1	-	-	0	-	-	0/1
M. Hohenfellner et al	2	-	2	-	-	2	-	2/2
MS. Wosnitzer et al	1	-	1	-	-	1	-	1/1
Mosiello	14	-	7	7	-	6	4	10/14

Our own series showed an overall success rate of 71.4%, versus 58 % in the literature studies. Considering different pathologies, incomplete spinal cord injury (SCI) presented the highest success rate; 100% in the literature and 75% in our own experience. The lowest rate was reported in complete SCI and myelomeningocele (0%).

Success Rate %	Acquired Incomplete	Acquired Complete	Congenital MMC	Congenital OSD	Overall
Our study	86%	NA	NA	57%	71.4%
Literature	100%	0%	0%	NA	58.0%

Discussion

SNM has been included from 2005 in the treatment algorithm forn NBD in adults (13) and SNM was confirmed during time as an effective alternative therapeutic option in adult population suffering by NBD (1). In pediatric and adolescents population because limited experiences there is not recommendation regarding the use of SNM in NBD(11), and different forms of electrical stimulation are commonly used in the treatment of pediatric lower urinary tract dysfunctions(14).

We started our own experience in 2008 after a training period of some months in NeuroUrology Centers and under adult urologist tutorial for the first 2 implants performed in our Institution. We decide to select patients either from the clinical point of view either using diagnostic tests, as urodynamic in order to select patients who could be theoretically good candidates for SNM. Furthermore, according to the tutorial practice we have used ASIA scale evaluation and neurophysiological test, as lower limb senonsory evoked potentials, to select the most preserved side that we have considered as the best choice for SNM . According to the tutorial technique we decide to use the two stages technique, always with local anaesthesia. The preoperative selection has been very useful, reducing the operative time, a critical point considering the fact that we have performed surgery using local anaesthesia in a very young population, with reduced compliance respect to adults. For this reason the intraoperative use of xray in order to check the position in the third sacral foramina has been effective too. According to the preoperative selection we observed a 100% rate of success in the side selection of best response: in 8 patients the intraoperative response was so higly effective that we decided that was not necessary check the other side, in 6 patients we were not completely satisfied and for this reason we have checked the other side confirming after the bilateral intraoperative stimulation the first choice. We observed globally an high rate of success (71.4%). Anyway we are consciousness about the reduced number of patients with a long-term

follow-up and for this reason we decide to compare our results with the literature data. We did this in order to get a bigger population and to get a better insight for the best indication of SNM in children with NBD. Anyway in the studies which were found, the overall level of evidence was low according to the Oxford Centre for Evidence-Based Medicine(22).
About these pediatric studies , Only one was focused on NBD only (8), while the others included non-NBD patients as well as patients with faecal or mixed incontinence or didn't describe the exact outcome for each patient separately. (9, 10). We have experienced difficulties extracting the needed data due to this high between-study heterogeneity and discrepancy of the results.

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The first published study on SNM in children (8) was a prospective randomized study focused mainly on patients with SB, where authors compared urodynamic outcomes and incontinence in 2 group of patients :SNM or oxybutynin .
Comparison of urodynamic variables at each study time disclosed no statistical significant difference between the implant and control groups with regard to compliance, bladder filling pressure and post-void residual. A significant increase ($p<0.05$) in leak point pressure was noted in patients treated with SNM . Controversially at the end of the study functional bladder capacity was significantly greater in the control group. The author conclusion was very interesting stressing the possible role of patients's selection in order to increase effectiveness.

In 2010 Haddad M et coll. published a prospective, randomized, open-label, crossover study on SNM in children older than 5 years old with urinary and fecal incontinence, mainly related to neurological disease. The great value of the study has been the ability demonstrate the real effectiveness of SNM with a positive response on urinary (81%) and bowel (78%) function. Cystometric bladder capacity increased during sacral neuromodulation. There was no significant change in other urodynamic or manometric parameters.

of the paperThe neuromodulators were implanted in a total of 33 patients and the children were randomly divided into one of two groups. The neuromodulators of group one were 6 months ON followed by 6 months OFF, and group B had the opposite sequence. The two phases were separated by 45 days to return to baseline status. Patients were classified as responders or nonresponders regarding urinary and fecal performance after each phase of the ON and OFF sequence. Response was defined as resolution of urinary leakage and-or fecal soiling with no need for pads, or a decrease of more than 50% in the number of leaks and/or soilings with minimum protection needed between the beginning and end of each sequence. All other findings were scored as ‘no response’.

. Overall positive respose rate was more than 75% for. They concluded that sacral neuromodulation is more effective than conservative treatment for both types of incontinence[2].

A retrospective study of Luitzen-Albert Groen et al included 18 patients, of which 5 with neurogenic bladder. The use of sacral neuromodulation was studied to treat for dysfunctional elimination syndrome and neurogenic bladder, as well as for bladder overactivity and Fowler syndrome.

Criteria for IPG placamento were 50% reduction of incontinence episodes, 50% in post-void residual volume, 50% reduction of necessity for CIC and 50% improvement in urinary frequency.

Outcome was defined as 1) full response, ie 100% patient satisfaction and greater than 90% objective improvement for at least 1 implantation criterion; partial response, ie patient satisfaction nd 50% to 90% objective improvement for at least 1 implantation criterion, and 3) failure, ie less than 50% objective improvement or no patient satisfaction.

Of the 5 patients with neurogenic bladder 3 suffered from urinary incontinence, 2 from enuresis, 2 from encopresis and 4 from recurrent UTIs. In all 3 patients with MMC the IPG was removed because of disappointing results. The patient with anal atresia had a full response, with greater than 90% decrease in incontinence episodes, and the patient with Guillain- Barre syndrome had less urgency, incontinence
and enuresis[5].

Due to a lack of studies sacral neuromodulation remains questionable. Subgroup analysis shows that the predictive value of the positive response of sacral neuromodulation depends on the specific indications. Two studies have been showing that children with MMC respond disappointingly on sacral neuromodulation[2,4]. Van der Jagt PK et al currently published a study on the investigation of the nerves in the sacral plexus in humans using diffusion tensor imaging (DTI) and fiber tractography. Not only did they use data from 10 healthy adults, but they added also one 12-year-old patient having spina bifida and neurogenic bladder dysfunction. This new methodology may provide a possibility to better analysis and diagnosis of neurogenic bladder dysfunctions[5].

Further studies will be necessary to evaluate the true advantage for children with neurogenic bladder.

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Mario Patricolo and June Rogers

Bladder and bowel problems are common in children with learning disabilities

Often attributed to disability itself and many are treatable

Adolescents and young adults with disabilities represent a particularly challenging patient's group and age group

Bladder and bowel management need to be tailored in view of several associated systemic and localized comorbidities including psychological issues

Currently the published literature on this subject is limited

200 conditions associated to incontinence in all ages and

40 relevant to adolescents and young adults

The most frequent conditions seen in the incontinence clinics for adolescents and young adults are MMC, DS, Sanfilippo syndrome, BW, diabetes/obesity, cerebral palsy

All the above present associated comorbidities influencing bowel and bladder function

2 sample groups chosen for more detailed analysis of conditions, genetic or metabolic causes, associated anomalies, associated comorbidities, available treatments and available resources within hospitals and community healthcare

Trisomy 21 – Down Syndrome (DS);

Mucopolysaccaridosis type III – Sanfilippo disease (MPS3).

Urinary and fecal incontinence, chronic constipation with fecal soiling, are devastating conditions for the

Require complex management

The above conditions, including the ones of neurogenic etiopathogenesis, can be frequently associated to renal/intestinal failure

Do not receive, in a large number of cases, adequate hospital or home care, in many geographical areas.

- In this 2 collated lectures…….

- Continence problems in children with learning disabilities
- Problems specific to Down's syndrome
- Why changes to practice are needed
- Key Points…….
- Children with physical and learning difficulties have a higher incidence of lower urinary tract symptoms
- Problems include manual dexterity, psychological factors, fluid intake and diet
- Children with *Down's Syndrome* and *Sanfilippo Disease* are particularly at risk of both upper and lower urinary tract anomalies
- The incidence of hypospadias in boys with Down's syndrome is approximately 6.5%
- Gastrointestinal abnormalities, both structural and functional, affect up to 77% of all individuals with Down's syndrome

Children and young people with physical and learning disabilities frequently experience bladder and bowel dysfunction

Improving outcomes for this group of children can present substantial challenges to health professionals, who need to be aware of comorbidities, including psychological issues

Literature on this subject is limited. However, there is evidence that underlying comorbidities influencing bladder and bowel function are often either missed or not recognized

Many factors that influence bladder and bowel function in children and young people with disabilities

These children might be late in being diagnosed due to difficulty verbalizing their needs and the assumption that their urinary or fecal problems are simply part of the disability picture.

Frequent misconception that if children with learning disabilities present with incontinence, the cause is some sort of developmental delay rather than an underlying bladder or bowel problem

Many of these children do not undergo a comprehensive bladder and bowel assessment. Instead, they have simple "pad assessment" and are issued with nappies

Health professionals in primary care may lack clinical knowledge and experience in this area, and there may be a shortage of trained home care and school nurses.

- The scale of the problem

Higher incidence of lower urinary tract symptoms in children with physical and learning difficulties

(Hicks et al, 2007; Duel et al, 2003; Handel et al, 2003; Roijen et al, 2001; van Laecke et al, 2001)

A study by de Waal et al (2009) identified that individuals with moderate to severe learning difficulties have risk factors for developing pathological post-void residual urine, indicating poor bladder emptying

A third of all children with cerebral palsy in a study by Ersoz et al (2009) were also shown to have significant post-void residual urine

It appears that children with Down's syndrome are particularly at risk of both upper and lower urinary tract anomalies

- Genitourinary problems associated with Down's syndrome
- Down's syndrome is a chromosomal abnormality, individuals are at increased risk of congenital conditions, including cardiac and gastrointestinal defects, as well as metabolic and renal diseases.
- Renal and urinary tract anomalies have received less attention than other congenital malformations.
- An issue for this group of children is that others may have a low expectation of their ability to be toilet trained and achieve full continence
- As a result, wetting problems are often attributed to an inability to achieve normal milestones rather than as a symptom of an underlying pathology.
- Genitourinary problems associated with Down's syndrome
- In 1960, Berg noted link between renal anomalies and Down's syndrome
- 3.5% of autopsies showing renal malformations
- Higher incidence of up to 21% (Ariel et al, 1991)
- Hypospadias and urethral abnormalities, such and posterior urethral valves (PUV) have also been noted in this population
- Hypospadias occurs in 0.3% of all live-births, with the incidence in boys with Down's syndrome being approximately 6.5%, an almost 20-fold increased risk (Lang et al, 1987)
- Genitourinary problems associated with Down's syndrome
- Overall prevalence of renal and urinary tract anomalies in the Down's syndrome population, including posterior urethral valves 4-5 times higher than in the general population (Kupferman et al, 2009)
- Dysfunctional voiding of urine is more common in Down's syndrome than in the general population
- The reasons for this dysfunctional voiding are not clear, but it may be related to overtraining of the pelvic floor in an attempt to encourage the individual to stay dry.
- Genitourinary problems associated with Down's syndrome

Hicks et al (2007) carried out a study to explore whether boys with Down's syndrome might have bladder outflow obstruction secondary to detrusor sphincter dyssinergia (DSD).

They identified that these children were at increased risk of renal injury and found that 50% of boys studied required urinary diversion for dilated upper urinary tracts following bladder outflow obstruction

77% had bladder dysfunction and 68% had a history of wetting

They concluded that the risk is not fully appreciated and it is important that all children and young people with Down's syndrome, have detailed history and a bladder scan.

- Genitourinary problems associated with Down's syndrome

DSD has also been reported in adult patients, and while most common in boys, it has been reported in a female with Down's syndrome (Kai et al, 2007; Culty et al, 2006).

The relatively high incidence of urinary problems in individuals with Down's syndrome indicates the need for assessment, regular reviews and investigations if required

This will facilitate early diagnosis, prompt treatment intervention and help to prevent upper urinary tract deterioration.

- Gastrointestinal function

Gastrointestinal abnormalities, both structural and functional, affect up to 77% of all individuals with Down's syndrome (Moore, 2008)

Hirschsprung's disease (congenital megacolon) and anorectal malformations, including imperforate anus (partial or complete obstruction of the anal opening), are more common in DS

If not well managed and treated in early childhood, they can lead to chronic problems in adulthood.

- Factors contributing to bladder and bowel dysfunction
- Reduced dexterity and posture issues
- Renal failure
- Associated metabolic conditions
- Psychological conditions such as depression or psychosis
- Short bowel syndrome
- Gastrostomy feeding

- Swallowing difficulties affecting fluid intake and diet
- Dietary intolerances
- A paradoxical or allergic reaction to essential medication (anticholinergics, alpha-blockers, laxatives)
- Forgetfulness regarding medication intake or deliberate avoidance
- An audit of 57 adults with Down's syndrome identified a range of gastrointestinal problems (Wallace, 2007):
    - Coeliac disease (12%)
    - Constipation (19%)
    - Unexplained diarrhoea (19%)

Wallace recommended that specially designed protocols should be developed to help identify and manage these problems

- Sanfilippo Disease

MPS3 is a lysosomal storage disorder caused by missing or defective enzymes

3 types, each one due to the alteration of a different enzyme needed to completely break down the heparin sulfate sugar chain

1:85.000 live births, male and female 1:1 ratio

Always progressive and life limiting

The lack of the enzymes fails to break the heparin sulfate down which is an essential component of the connective tissue, causing the

accumulation of glycosaminoglycan in nearly all cell type

Symptoms start between 2 and 4 years

Associated to severe neurological symptoms (progressive dementia; aggressive behavior; hyperactivity; seizures; severe sleep disorders)

Bone abnormalities, skin diseases, scoliosis and respiratory obstruction are associated to MPS3.

Some will die in teenager years, but a significant number of patients will survive into their 30's, 40's and even 50's

Most prominent feature of Sanfilippo disease is degeneration of the central

nervous system

Bone, muscle and joint disease progress, progressive loss of dexterity and ambulation

Feeding ability also deteriorates and gastrostomy tube (GT) insertion is

performed to allow GT feeds.

Incontinence and diarrhea become severe at this stage

Scoliosis is severe in most cases; overflow fecal incontinence due to “obstipation”

Dementia deteriorates; tissue healing becomes poor

Those, whose degree of dementia and physical deterioration is not too severe, may be violent, depressed, self-isolating and catalepsy may occur when under emotional stress or when incontinence worsens

- No treatment is available for the underlying cause of the disease
- Intrathecal enzyme replacement is being studied at present and gene therapy is also subject of active research
- Substitute reduction therapy, glycosaminoglycan production has been used in MPS3. I

In early years MPS3 patients are hyperactive and accident prone, but when spasticity establishes, dexterity and ambulation are lost

Physiotherapy and hydrotherapy and all the available neurorehabilitation techniques are mandatory.

Some MPS3 cases can be toilet trained, but as the neurological disease progresses they will lose sensation of being wet or soiled and the vesical innervation and bladder/bowel sphincter innervation are compromised inducing neurogenic bladder and bowel and severe incontinence with obstipation and soiling

Patients affected by MPS3 need special school-nursing and 1:1 support.

The requirement for direct nursing care rises to 2:1 when somatic paralysis and dementia become more severe.

The home and school environment requires adapting to the patient’s condition.

A few hospices have recently expanded the service to provide appropriate respite service to young adults. For Sanfilippo diseases cases the transition from paediatric to adult services can be very problematic and needs direct and good communication amongst teams.

An MPS Society exists and resources and information can be gathered on their website: www.mpssociety.org.uk

- Constipation

Constipation particular problem in learning and physical difficulties

– poor mobility

– altered muscle tone

The insidious onset of constipation may not be recognized by individuals who have reduced ability to perceive and report their symptoms

Often first sign is that the patient starts to soil due to underlying fecal impaction

It is important not to presume that the development of fecal soiling is due to the person developing a behavioral issue or "incontinence", and to ensure that they are fully investigated

- Implications for practice

Currently in UK ICP's for children and young people with disabilities

who have comorbidities influencing bladder and/or bowel function, especially

with regard to transition from paediatric to adult care

Many Families and healthcare providers are not aware of the higher risk

of underlying comorbidities

Result:

–Urinary incontinence

–Fecal soiling

These Patients are not often offered early basic continence assessments or treatments, increasing the risks of urinary infections, and renal damage and intestinal compromise

- Implications for practice

Specific groups, such as those with DS present with high incidence of DV, polyuria, risk of dehydration.

Dysfunctional voiding and DSD cause increased Pdet and PVR

- Implications for practice

Understanding of the need for regular medication for constipation may be reduced due to communication issues, depression and autism

CIC and CSIC, bowel wash-out, rectal washouts or enemas, and laxative use may also be difficult

Simple measures such as correcting fluid intake, regular toileting and introducing medication as necessary, can make a huge difference in terms of improving bladder and bowel problems.

- What is needed and what are we doing?

A transition plan has to be put in place for these patients, with specific tailoring for their age and in

consideration of their disability.

ICS CYAC has planned the following

- "Phase 1" – analysis of the comorbidities (completed)
- "Phase 2" – identification of care pathways (ongoing for DS)
- "Phase 3" – propose a globally applicable standardization.

- What is needed and what are we doing?

Comorbidities have been divided in categories:

– Bladder and urinary system

– Bowel and gastro-intestinal (GI) system

– Systemic compromise and organ Failure (CKD, ESRD, Liver Failure, etc)

– Impact of learning disorders, psychological/psychiatric conditions on bladder/bowel management.

– Impact of paraparesis and tetraparesis, (postural issues, dexterity, etc.)

– Others

- Conclusions

All children presenting with bladder and young adults with bladder and bowel problems should have equal access to bladder and bowel (continence) services regardless of any associated learning or physical disability

Presumptions should not be made as to the cause of the bladder and/or bowel problems and all children should undergo appropriate

assessment to exclude any underlying pathology

The risk is that untreated bladder and bowel problems, including

incontinence, will persist into adulthood

A transition plan should be put into place for those young people, with specific tailoring for their age and their disability

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Bladder and bowel dysfuncion in children with learning disabilies

Jianguo Wen, Giovanni Mosiello

Introduction

Bladder and bowel dysfunction (BBD) is used to describe children with a combination of functional bladder and bowel disturbances.[x,x,x]Obviously, BBD means loss of voluntary control over bladder and bowel function which is distressing and disabling, causing limitations to a person's self-esteem and social participation. Symptoms of BBD include lower urinary tract symptoms (LUTS) such as UI (urinary incontinence), DV (dysfunctional voiding) and recurrent urinary tract infections and functional defecation disorders, including constipation and FNRFI (functional nonretentive fecal incontinence) are far more common than generally accepted. Parents and/or children even doctors often neglect combined signs. Most forms of urinary incontinence are not caused by an anatomic or physiologic abnormality and become more difficult to diagnose. Their management needs the knowledge of BBD,[x] especially in children with learning disabilities.

Pathophysiology

Central nervous system (CNS) disorders such as learning dysfunction can cause a range of bladder and bowel dysfunctions that affect the quality of life with those neurological conditions. Both animal studies and clinical data support bladder-bowel cross-sensitization, or crosstalk. Many literatures have been shown that the potential roots for the persistent connection between bowel and bladder and the role that the central nervous system plays in affecting both. On a functional level both in animals and humans, bowel distention affects bladder activity and vice versa. It has been reported that convergent neurons in the bladder and bowel as well as some superficial and deeper lumbosacral spinal neurons receive afferent signals from both bladder and bowel in the rat. Clinically, the bladder-bowel relationship is evident through the presence of urinary symptoms in patients with irritable bowel syndrome and bowel symptoms in patients with voiding dysfunction. An ever-increasing pool of knowledge drawn from multiple medical disciplines has provided us with a wealth offunctional imaging information that is allowing us to map the areas of the brain.[x]

Both Normal micturition (bladder emptying) and defecation require both an intact central and peripheral nervous system to control the bladder filling, voiding phase and the bowel defecating phase. A cephalomeningitis, and possibly acquired brain injury damage to the cortical bladder centre and defecation centre, causes a loss of inhibition of the sacral reflex arc. This can result in bladder urgency and incontinence and loss of coordination between rectal contraction and anal constriction, and a loss of awareness of the need to defecate. For example, as the frontal lobe of the brain is responsible for voluntary control of voiding, damage to this area will cause an unstable bladder. Damage to the micturition pathways in the pons will cause detrusor hyperreflexia or detrusor sphincter dyssynergia.

Besides, the pathological state of bladder and bowel could impact each other. Rectal distension puts direct pressure on posterior bladder wall and leads to bladder overactivity or mechanical compression of bladder with trigonal irritation, post bladder wall invagination, bladder and urethral obstruction or distension. Urethral and sphincter neural inputs are one functional with shared input to reflexes from bladder, bowel and proximal urethra.

The ability to maintain normal continence for urine and stools is not achievable in all children by a certain age. Gaining control of urinary and fecal continence is a complex process, and not all steps and factors involved are fully understood. While normal development of anatomy and physiology are prerequisites to becoming fully continent. Neurogenic disturbances that can usually be recognized at birth and cause incontinence, will require specialist treatment, not only to restore continence but also to preserve renal function.**Error! Bookmark not defined.**

Clinical features

Symptoms and signs of BBD include bladder overactivity (urinary frequency and urgency, incontinence), prolonged voiding intervals, daytime wetting, perineal and penile pain, holding manoeuvres (posturing to prevent wetting), constipation, and encopresis and fecal incontinence. They are distressing and embarrassing, affecting a person’s physical and psychological wellbeing. These medical issues can have social repercussions and ultimately have an impact on a person’s quality of life. Patients may become depressed, socially isolated and then suffer from marital and family disharmony. Loss of voluntary control over bladder and bowel function in BBD children, which is distressing and disabling, causing limitations to a person's self-esteem and social participation. Children with BBD may be bullied at school. Incontinence can affect parent–child relationships and the child may develop a poor self-image and have difficulties with social contacts, especially interacting with their peers. Over half of children with cerebral palsy have urinary continence problems, and are therefore likely to experience similar psychosocial problems. These problems are likely to become worse as the person progresses into adulthood. The reported prevalence of childhood constipation varies widely (median 12%,range 0.7% to 29.6%). One or more symptoms of disturbed bladder control are present in 26% of school-agechildren. LUTS occur in approximately 30% of children who present with constipation. In children with FNRFI the prevalence of daytime and nighttime UI is 46% and 40%, respectively.

Evaluation

The first step is to identify the children and look for those at risk via: through medical history; complete physical examination; bladder and bowel diary; urinalysis; urine flow measurements; post void residual urine; transabdominal ultrasound.

It is recommended that bladder diary and bowel diary is basic evaluation of BBD. Uroflowmetry, transabdominal ultrasound .Urodynamic investigation with or without EMG testing should be considered only in selected cases

. In addition to UDS, a renal/bladder ultrasound is always used together. If ultrasonography reveals hydronephrosis, ureteral dilation, a discrepancy in renal size or contour, or increased bladder wall thickness, or UDS reveal DO or poor compliance, elevated leak point pressure and DSD, voiding cystourethrography (VCUG) is warranted looking for vesicoureteral reflux and/or bladder outlet obstruction. High-grade reflux necessitates CIC and anticholinergic medication, whereas low-grade reflux, especially when DLLP is low and compliance is good, may be managed expectantly.

Cystoscopy, MRI of the lumbosacral spine, colon transit time and Anorectal manometry should performed if necessary.

Treatment

There are a wide range of options to manage the BBD. The overall aim for treatment of bowel dysfunction is to obtain regular bowel emptying, continence, and independence by establishing a bowel management program tailored to meet the needs of each child.

Starting with the development of adequate X-ray assessment and reliable UDS, the advent of clean intermittent catheterization (CIC), artificial sphincter implantation, behavioural modification, biofeedback, a plethora of drug therapies that modulate lower urinary tract function and a multitude of rehabilitative surgical techniques may be selected.

Bowel and bladder issues have been noted to be coexistent in children, and treatment of bladder symptoms without concomitant targeting of bowel issues generally leads to failure. Presently, the Common consensus on BBD are managing bowel symptoms before intervening for bladder dysfunction, and first dealing with daytime LUTS then nighttime LUTS. For example, functional gastrointestinal disorders, such as constipation, can contribute to the development of lower urinary tract symptoms, including OAB symptoms, and treatment of OAB with antimuscarinics can worsen constipation, a common antimuscarinic adverse effect. The initial approach to treating coexisting constipation and OAB should be to relieve constipation, which may resolve urinary symptoms[6]. However, treatment of BBD should be individualized, directed at symptomatic and objective improvement.As those learning dysfunction patients can't take care of themselves, nurses have an critical role to play in dealing with those BBD patients. Besides, nurse also play important role in maintaining privacy and dignity. The Nursing and Midwifery Council identifies the principles of treating people as individuals, respecting their dignity, and supporting people in caring for themselves. Needing help with urinary elimination or with intimate procedures is embarrassing and, if handled insensitively by nurses, can lead to feelings of degradation and loss of self-esteem. Privacy and dignity can be aided by simple measures, such as ensuring that bedside curtains are closed, toilet doors are shut and that patients are covered up and exposed as little as possible.

Follow-up

Children with learning dysfunction were found usually in the toddler stage. During this time a yearly or biannual ultrasound is recommended to follow the child, looking at residual urine or changes in the degree of hydronephrosis or bladder wall thickening. If any one of these is noted, UDS should be reconsidered. When they reached their teens, ultrasonography should be performed yearly looking for changes in kidney dilation and/or bladder wall thickening. The need to do CIC more frequently, new onset wetting, or recurrent UTI are indicators of potential changes in lower urinary tract function. In such situations, UDS is warranted in the former two conditions. Once the growth velocity has diminished in adolescence follow-up ultrasounds can be performed at 2 years intervals. It is important for the practitioner to consider that adolescent hormonal changes may impact the lower urinary tract. It has been shown bladder outlet resistance may increase inteenagers, the result of prostatic enlargement in boys and estrogenization in girls.

Conclusion

In conclusion, neurological causes of bladder and bowel dysfunction are a challenge for patients and the healthcare team. Management of neurogenic bladder and bowel needs the coordination of a range of professionals, and nurses working with patients with neurological conditions need to develop the skills and knowledge to enable them to contribute to a multi professional approach to neurogenic bladder and bowel management. Treatment of defecation problems in children with BBD enhances successful management of LUTS. Thorough assessment, support and information will enable suitable treatment options to be offered so that patients are able to choose a bladder and bowel management program that enables them to enjoy a high quality of life.

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Disabilities affecting Continence and Bowel Function + Addressing Continence In Children With Learning Disabilities

-Disabilities and Incontinence: The Power of the Mind

Jeff Lazarus, MD, FAAP

Introduction

Learning Objectives

1. What hypnosis is and isn’t.
2. Why hypnosis?
3. To learn who is an appropriate patient for medical hypnosis.

What is hypnosis? Hypnosis is not……….…

What is hypnosis? Highly focused state of mind.

Example: “highway hypnosis”

Other Examples of Trance

Other Terms for Self-Hypnosis: Medical hypnosis, Clinical hypnosis,Mental imagery

Guided imagery Visualization, Daydreaming with a focus,Believed-in imagination

Uses for medical hypnosis:

Pain ,Headaches ,Nocturnal enuresis (bedwetting), Tics with or without Tourette Syndrome, GI problems

Uses for medical hypnosis: Performance anxiety (test, recital, sports)

Performance enhancement (same as above): Habits,Phobias, Insomnia,Weight control

Nocturnal Enuresis

Who is an appropriate patient?

Monosymptomatic NE primary ,secondary

Dysfunctional Elimination Syndrome

Pollakiuria

Medical Problems that can cause PNE

Constipation / encopresis

Sleep apnea / enlarged tonsils, Spina bifida, Diabetes insipidus ,Diabetes mellitus

Urinary tract infection, Urethral, genital, or midline skin abnormalities,Seizures

Why Hypnosis?

Ineffective Treatments for PNE

Punishment

Night-waking

Fluid restriction

Medications vs. Placebo

Medication offers 1-2 more dry nights/week compared to placebo.

Placebo effect 37-59% Require significant parental involvement

Do not teach continence skills Extremely high relapse rate

Enuresis Alarm

Reduces NE in 2/3 of patients, ½ of these relapse when alarm is discontinued.

Require significant parental involvement, Can take up to 16 weeks to work

If no change after 6 weeks ->probably no complete response

Often wakes up everyone in the home except the patient

Does not teach continence skills

PNE: 1st Self-Hypnosis Series 40 children aged 4-16 years taught SH

31 were dry, usually within first month, 6 others improved,3 did not improve

1 – secondary gain, 1 – did not practice SH,1 – needed urologic surgery

Self-Hypnosis

1979 – Stanton

28 children, 7 – 18 years old, 20 were dry within 1 to 3 visits ,of these, 15 still dry 1 year later

Self-Hypnosis

1984 – Kohen

257 children 44% completely dry (dry 30 nights and one year later without relapse)

31% had significant improvement most had already tried alarm system o pharmacotherapy, including imipramine

Failures:children who were not motivated parents too involved

Hypnosis for DES: Literature Review

Unable to find any studies on this. The concepts and training are the same.

I view hypnosis as biofeedback without being hooked up to the uroflowmeter.

I would imagine that this is what patients do when they are at home, and not in the office with the uroflowmeter. They visualize what they've learned, and, mental imagery can create muscle memory.

Biofeedback – Uroflowmeter

Need 2 main things for therapy to work Medical Hypnosis Is a Tool Typically significant improvement after only 2–3 visits

Notes