Journal Pre-proof

CLINICAL EXPERIENCE WITH MIRABEGRON IN PEDIATRIC PATIENTS WITH SPINA BIFIDA UNDER 3 YEARS OF AGE

Ioana Fugaru, MD, Brian VanderBrink, MD, Katie Mueller, APRN-CNP, Pramod Reddy, MD, William DeFoor, MD, Eugene Minevich, MD, Andrew Strine, MD, Michael Daugherty, MD, Assistant Professor

PII: S1477-5131(26)00408-0

DOI: https://doi.org/10.1016/j.jpurol.2026.106129

Reference: JPUROL 106129

To appear in: *Journal of Pediatric Urology*

Received Date: 16 December 2025

Revised Date: 15 June 2026

Accepted Date: 25 June 2026

Please cite this article as: Fugaru I, VanderBrink B, Mueller K, Reddy P, DeFoor W, Minevich E, Strine A, Daugherty M, CLINICAL EXPERIENCE WITH MIRABEGRON IN PEDIATRIC PATIENTS WITH SPINA BIFIDA UNDER 3 YEARS OF AGE, *Journal of Pediatric Urology*, https://doi.org/10.1016/j.jpurol.2026.106129.

CLINICAL EXPERIENCE WITH MIRABEGRON IN PEDIATRIC PATIENTS WITH SPINA BIFIDA UNDER 3 YEARS OF AGE

Authors: Ioana Fugaru [1], MD; Brian VanderBrink [1], MD; Katie Mueller [1], APRN-CNP; Pramod Reddy [1], MD; William DeFoor [1], MD; Eugene Minevich [1], MD; Andrew Strine [1], MD; Michael Daugherty [1], MD.

Affiliations: Division of Pediatric Urology, Cincinnati Children's Hospital, Cincinnati, Ohio, United States of America.

Conflicts of Interest: None.

Corresponding author:

Michael Daugherty, MD, MHI

Assistant Professor, Division of Urology

Michael.Daugherty@cchmc.org

513-636-4975

CLINICAL EXPERIENCE WITH MIRABEGRON IN PEDIATRIC PATIENTS WITH SPINA BIFIDA UNDER 3 YEARS OF AGE

Abstract

Introduction: Mirabegron suspension, a beta-3-agonist [B3], has been approved in the United States for use in pediatric patients older than 3 years of age in 2021. We sought to evaluate the safety, tolerability and impact on urodynamic studies of the introduction of B3 in the management of neurogenic bladder for children younger than 3 years with spina bifida at our center.

Methods: A retrospective study was performed at our institution with spina bifida patients younger than 3 years old treated with off label use of B3. Patients were stratified into three clinically distinct groups (primary, adjuvant, and alternative therapy). Patients were seen for the first outpatient urological visit at 3 months of age and subsequently underwent clinical and urologic evaluation at various timepoints. Patient demographics, clinical information and investigation results were extracted from the medical record.

Results: 19 patients received B3 at a median age of 24 months (IQR 13-29 months). Four patients were primarily treated with B3, ten patients were switched to B3 due to intolerable adverse effects of antimuscarinics [AM] (AM to B3) and five patients received it as adjunct therapy (B3+AM). The measured bladder compliance was improved in all but one of the patients exposed to B3. Bladder capacity increased in patients on primary or adjuvant B3 and was preserved in patients on B3 as alternative to AM. All ten (10) patients who were on alternative B3 reported resolution of the AM adverse effects which motivated the pharmacological agent change. The medication was not discontinued in any patient due to adverse effects.

Conclusions: Spina bifida patients with neurogenic bladder younger than 3 years old may benefit from additional therapy with beta-3 agonist, particularly those experiencing intolerable adverse effects from antimuscarinics.

Introduction

Patients with congenital neurogenic lower urinary tract dysfunction (NLUTD) caused by spinal bifida, may benefit from early and proactive management for bladder and renal function protection [1-4]. Indeed, significant advances have allowed for the prenatal closure of spina bifida, with evidence supporting a benefit towards decreasing need for ventriculoperitoneal shunting and for improving lower motor neuron outcomes, while the urological impact of prenatal closure of myelomeningocele remains to be determined [5]. Urological goals of care in the pediatric spina bifida population evolve with age along with patient and family needs and abilities. Antimuscarinic medications have been traditionally used in this patient population to assist with bladder compliance, detrusor overactivity, leakage, and overall bladder capacity [6, 7]. The most used antimuscarinic (AM) in the young pediatric population has typically been oxybutynin, notably due to its low cost, availability as a syrup formulation, and urologist familiarity with the drug [6]. However, oxybutynin has been associated with a significant adverse effect profile which includes behavioral changes, flushing/overheating, tachycardia, xerostomia, urinary retention and constipation. While there are no studies for the pediatric population, chronic and high dose use of oxybutynin has also been associated with cognitive decline in the adult population [8-10]. There are sparse alternatives to oxybutynin in the pharmacological management of NLUTD in young children, mainly consisting of escalation of therapy with botulinum toxin or operative management [11].

Mirabegron, a beta-3 agonist (B3), has been approved in the United States by the FDA for use in pediatric patients ≥ 3 years old in March 2021, under the oral pill and suspension (granules) formulations [12]. We sought to evaluate if mirabegron, known to have a more favorable adverse effect profile, would be a safe and well tolerated adjunct or alternative to AM in young patients with NLUTD. We aimed to evaluate the safety, tolerability and impact on urodynamic studies of the introduction of B3 in the management of neurogenic bladder for children <3 years old. We hypothesized that B3 is well tolerated in the young pediatric population and that it can improve or maintain bladder function parameters.

Materials and methods

We performed a retrospective study at a single institution where patients seen in a spinal dysraphism clinic were treated with off-label mirabegron prior to the age of three after shared-decision making with the parents. This study received IRB exemption. Patients were seen at an outpatient multi-disciplinary clinic from January 2022 to January 2025. Patients were only included that had a diagnosis of spina bifida, had been prescribed and taken Mirabegron and were under the age of 3 at time of initiation of therapy. Patients that had any other baseline diagnoses, over the age of 3 at time of medication initiation and those patients with spina bifida that never received a prescription for Mirabegron were excluded from the study.

Patients that are seen at our institutions multidisciplinary clinic follow the clinical pathway that their initial outpatient visit is scheduled at 3 months of age, and patients were seen at regular visits typically at 6, 9, 18, 24, 30, and 36 months and every twelve months thereafter. Patients are evaluated with renal bladder ultrasounds (RBUS) at each clinic visit. They obtain a VCUG prior to leaving the hospital postnatally and this is repeated annually (unless clinical scenario warrants sooner testing such as onset of febrile urinary tract infections, upper tract changes seen on RBUS, change in urinary continence or change in renal function). An initial urodynamic or videourodynamic study (V/UDS) is obtained at the 6 month visit and this is repeated annually (unless clinical scenario warrants sooner testing such as onset of febrile urinary tract infections, upper tract changes seen on RBUS, change in urinary continence or change in renal function). When a bladder medication (anticholinergics or mirabegron) is started for a patient the goal is to repeat the V/UDS testing within 3 months to assess the response to therapy.

The V/UDS obtained at our institution were performed on institutional protocol based on the International Children's Continence Society guidelines [13]. The V/UDS performed at our institution include only the filling cystometry in this patient population. Bladder filling and vesical pressures were measured with a dual-lumen transurethral catheter and abdominal pressure was measured through a rectal balloon catheter. The filling rate of either normal saline or contrast agent used for the filling cystometry was recorded and calculated to be at physiologic filling rate. Compliance was categorized as normal or abnormal based on the ratio of the change in bladder volume to the change in detrusor pressure during bladder filling. Detrusor leak point

pressure (DLPP) and end filling pressure (EFP) were measured prior to detrusor overactivity (DO) or contractions. DO was defined as ≥ 2 contractions with an amplitude of ≥ 15 cm H2O over baseline. Compliance was defined as the change in volume/change in detrusor pressure, as defined by the International Continence Society, at the beginning and the end of the study [14]. Percent (%) bladder capacity was expressed as the maximal cystometric capacity/estimated bladder capacity [15]. For the estimated bladder capacity (EBC) of children under 2 years of age, the weight-based formula was used (kg x 7), and for children > 2 years of age, the age formula was used [(age + 1) *30] [14]. V/UDS was obtained 3-6 months after any bladder therapy change, including B3 initiation.

Patients born within our institution were placed on a clean intermittent catheterization (CIC) regimen prior to discharge from the neonatal intensive care unit. Patients that were deemed to have deterioration of bladder features and were already on CIC and antimuscarinic (AM) were placed on adjunct therapy with B3 at the discretion of the clinician and family. Features of bladder function deterioration typically included decreasing compliance, decreasing bladder capacity, increased DO, increased DLPP/EFP, new onset of upper tract changes, worsening of vesicoureteric reflux. Patients who could not tolerate AM therapy due to significant adverse effects were considered for B3 therapy as second-line agent. Finally, patients who were on CIC but required further interventions to improve bladder wall dynamics were also considered for primary treatment with B3, at clinician and family discretion, and warranting insurance approval. Shared decision-making and informed consent were obtained from the families before initiating B3 therapy, with the understanding that its use in children under 3 years of age is an off-label indication.

The patient electronic medical records were reviewed to collect patient demographic data, AM use and side effect information, B3 initiation, use and side effect information. Patients were initiated on a weight-based dose of the 8mg/mL B3 liquid suspension, and were typically started at 3 mL (24 mg) if >11 kg. Families were instructed to have a blood pressure measurement done at the primary physician's office prior to initiation of B3 and after 3-4 weeks on the B3 therapy. Data was extracted from RBUS and V/UDS whenever performed. Interpretation of urodynamic data was analyzed and collected retrospectively by a single author (IF) and reviewed by two senior authors (MD, AS). The collected urodynamic data consisted of: cystometric capacity,

functional capacity (defined as the bladder capacity when detrusor pressure reaches 40 cm H_2O), opening detrusor pressure, EFP, DO presence/absence, DLPP. Statistical analysis was performed using v.10 GraphPad Prism software. Basic descriptive statistical tests were performed.

Results

A total of 19 patients met inclusion criteria. All patients had a diagnosis of myelomeningocele in this cohort and 58% had a ventriculoperitoneal shunt placed postnatally (**Table 1**). Mirabegron was initiated at a median age of 24 months (IQR: 13-29 months). The median follow-up duration from initiation of mirabegron to follow-up was 10 months (IQR: 6-21 months). In 53% of patients, mirabegron was prescribed as an alternative to antimuscarinic therapy due to side effects experienced by the patient. In 26% of cases, mirabegron was used as an adjuvant therapy with antimuscarinic. Finally, 21% of patients were prescribed mirabegron as the primary pharmacological measure for their NLUTD. In patients who were treated with antimuscarinics throughout their care, only one received tolterodine, while all other patients received oxybutynin. Most (84.2%) patients were performing CIC as part of their individualized baseline management plan at the time of the first urological visit at the multidisciplinary clinic. There were no significant changes in the post-B3 reported blood pressure values by families (Supplemental Table 2).

Tables 2a, b and c present the main urodynamic features before and after the introduction of B3 in each subgroup of patients (primary B3, adjuvant B3 and B3 as alternative therapy). In summary, the % bladder capacity changed from 43% to 207% in the primary B3 group (p=0.19) and from 126% to 178% in the adjuvant group (p=019). In patients who received B3 as alternative therapy to AM, the % bladder capacity went from 118% to 90% (p=0.16). Similarly, DLPP/EFP values seemed to decrease in the primary and in the adjuvant B3 group, while remaining stable in the alternative B3 group.

Figures 1a, b and c illustrate the changes in the calculated bladder compliance in each subgroup of patients treated with B3. In the primary B3 group, all four (4) patients had an improved bladder compliance after initiating the medication (p=0.097) (Figure 1a). In the adjuvant therapy group, all patients had improved bladder compliance values after B3 initiation (p=0.067) (Figure 1b). Finally, in the patients who were exposed to B3 as alternative to AM, 80% of patients had an improved bladder compliance after B3 (p=0.97) (Figure 1c).

Each patient's individual urodynamic parameter progression is presented in Tables 3a, 3b and 3c by subgroup. Of the five (5) patients who were exposed to AM + B3 therapy, three (3)

156 families reported decreased leakage between each CIC (Table 3b). This trend was not observed
157 in the primary or the alternative B3 groups.

158

159

Discussion

In this cohort, patients with spina bifida under the age of 3, had therapy initiated with mirabegron at various stages of their care. Some received it as primary bladder pharmacotherapy, others as an alternative to poorly tolerated anticholinergic agents, and others as an adjunct to escalate treatment. Overall, mirabegron was well tolerated by all 19 patients and none had to stop therapy due to side effects.

Indeed, there is mounting evidence supporting the role of mirabegron as an adjunct to AM therapy in children >3 years old with neurogenic bladder as a means of escalating and optimizing pharmacotherapy [12, 16, 17]. A recent retrospective study by Gaines et al. of 103 patients with a median age of 10.7 years, who spent 166 days on combination therapy, demonstrated improved bladder opening pressures, improved EFP and decreased DO in 32% of patients [16]. Moreover, Taghizadeh et al. reported that in a series of 31 children with a median age of 8 years, there were favorable V/UDS changes in 80% of patients on B3 + AM combination therapy, after failing either mono-AM therapy or AM + botulinum toxin therapy [17]. In 2020, Sager et al. reported similar findings of improved cystometric capacity, decreased intravesical pressures and increased continence rates in patients with ages ranging from 7 to 17 years old [18]. However, patients with spina bifida require urological follow-up and treatment from birth and, to date, no studies have reported the impact of B3 therapy on children < 3 years old.

The well-known significant systemic side effect profile of AM (dry mouth, constipation, blurred vision, somnolence, flushing, pruritus) and its unknown long-term impact on the developing brain are important motivations to search for alternatives to this conventional therapy for all newborns with spina bifida. Although studies of the cognitive impact of AM in the pediatric population are sparse and suffer from significant bias due to difficulty in interpreting cognitive testing scores in varying age ranges, it is known that the majority of AM receptors are found in the brain and multiple studies have identified cognitive changes in the adult and geriatric population exposed to these agents long-term [6, 19-22]. Often the initiation of AM treatment for patients is not taken lightly and families have a lot of reticence regarding this medication, long-term usage, and side effects.

By reporting our clinical experience with B3 as either primary, adjuvant or alternative therapy to AM in the early stages of bladder management in patients with myelomeningocele, we aim to support the transition and use of alternatives to AM in patients <3 years old. Although reporting only a small cohort of 19 patients, the measured bladder compliance was improved in all but one of the patients exposed to B3. Bladder capacity increased in patients on primary or adjuvant B3 and was preserved in patients on B3 as alternative to AM. All ten (10) patients who were on alternative B3 reported resolution of the AM side effects which motivated the pharmacological agent change. All patients in the present cohort tolerated B3 well and the medication was not discontinued in any patient due to side effects.

The availability of B3 as oral granule suspension is a significant advantage making it a potential first-line treatment in young patients with neurogenic bladder. Limitations to the prescription of B3 in the younger pediatric population include its off-label use, and thus, the absence of standardized dosing for children weighing <11 kg, associated with potential difficulties in insurance approval as primary pharmacotherapy. In the current cohort, only 3 patients were initiated on B3 at a weight <11 kg, and these patients were started at a 20 mg dose (2.5mL of the 8mg/mL concentration), and titrated up to the recommended dose of 3mL when reaching 11kg. Furthermore, in patients who were observed to have a response to B3, but therapy escalation was still desired, B3 dose was escalated up to 6mL: however, by the time the patient had titrated to the maximal 6 mL titration, they were already > 3 years old. B3 can be used in patients with chronic kidney disease, however it is not recommended in patients with end-stage renal disease (eGFR < 15 ml/min/1.73 m2) or who require dialysis or in those with severe liver disease (Child–Pugh Class C) [12]. In our experience, insurance approval for B3 use as primary pharmacological agent in spina bifida patients is possible, but requires significant time and efforts from the treating team. Moreover, there are no prospective, randomized trials in this population allowing for the comparison of B3 to AM as initial pharmacotherapy in young infants with neurogenic bladder dysfunction.

Our study is limited by the small number of patients and the variety of combinations in which the medication was used. Moreover, obtaining and interpreting V/UDS in young children is an important limitation in the interpretation of the impact of B3 as first-line therapy in this population. For instance, in young infants and children, bladder capacity sensation cannot be

evaluated reliably. Moreover, bladder compliance in the pediatric population poses significant challenges: compliance changes with volume, and volume changes with age. There are no reliable reference values for the interpretation of compliance values in infancy, and bladder compliance is expected to increase with age [23]. Therefore, lower bladder compliance values in infants could reflect normal bladder compliance in the described population [23]. Thus, we believe the value of our study is in the comparison of the bladder compliance values of each child before and after the introduction of the medication, rather than determining if bladder compliance was normal or abnormal in itself. Finally, we hereby solely report the filling cystometry data, as it is not our institutional protocol to obtain both filling and voiding cystometry routinely. Furthermore, our study focuses only on urodynamic data, and does not aim to report on any changes observed in additional imaging studies (RBUS or VCUG) as this was not the primary endpoint of the study. These additional studies are regularly obtained for patients in this clinic, but none are solely used as the indication to start medications. This study again doesn't focus on indications for starting pharmacologic intervention but is looking at what changes the initiation of B3 has on urodynamic findings and was not attempting to describe or analyze other changes seen through additional testing. Nevertheless, none of the patients that were started on B3 had worsening imaging findings. This study provides initial data regarding the usage and feasibility of starting mirabegron in patients with spina bifida under the age of three. Given its once a day dosing and favorable side effect profile, Mirabegron suspension may be preferred by families and has the potential to improve quality of life in the young spina bifida population.

Conclusion

There is an opportunity to expand the array of options for infants and children under 3 years of age with neurogenic bladder by using the suspension formulation of mirabegron. Our study is the first to report the use of this medication in this population. No patient stopped the medication because of side effects. We believe that further prospective studies with standardized dosing and repeated longitudinal urodynamic testing will allow for the ongoing evaluation of the impact of this medication on bladder function.

249

250

251

252

253

254

255

256

257

Age at B3 initiation, months, median (IQR)	24 (13-29)
Female	9 (47.4%)
Male	10 (52.6%)
Use of mirabegron	
Primary therapy	4 (21%)
B3 as adjuvant to AM	5 (26.3%)
B3 as alternative to AM	**10 (52.6%)**
Presence of ventriculoperitoneal shunt	11 (57.9%)
Gestational age at birth	
> 37 weeks	8 (42.1%)
35-37 weeks	4 (21.1%)
32-35 weeks	6 (31.6%)
< 32 weeks	1 (5.3%)

Table 1. Patient demographic data

	B3 as primary therapy *(n=4)*	
	Before B3 Median (IQR)	After B3 Median (IQR)
Measured maximal cystometric capacity (MCC) (mL)	36.0 (25-123)	170.0 (71-191)
Percent bladder capacity [MCC/ EBC]	42.5 (33.3-280.0)	207.0 (92.0-243.3)
DLPP or EFP (cmH2O)	50 (8-101)	29 (26-39)
Compliance (ml/cmH2O)	0.8 (0.5-2.1)	5.0 (2.1 -6.7)

271 **Table 2a.** Main urodynamic features in the patients before and after exposure to mirabegron as
272 primary therapy for neurogenic bladder.

	B3 as adjuvant therapy to AM *(n=5)*	
	Before B3 Median (IQR)	After B3 Median (IQR)
Measured maximal cystometric capacity (MCC) (mL)	115.0 (45.5 -129.0)	160.0 (92.0-217.5)
Percent bladder capacity [MCC/ EBC]	126.0 (50.5-81.5)	178.0 (81.5-241.5)
DLPP or EFP (cmH2O)	55 (29 – 104)	35 (13 – 74)
Compliance (ml/cmH2O)	2.4 (0.5 – 4.8)	6.3 (1.7-16.0)

273 **Table 2b.** Main urodynamic features in the patients before and after exposure to mirabegron as
274 adjuvant therapy combined with antimuscarinics for neurogenic bladder.

275

276

277

278

279

	B3 as alternative therapy to AM *(n=10)*	
	Before B3 Median (IQR)	After B3 Median (IQR)
Measured maximal cystometric capacity (MCC) (mL)	96.0 (63-130)	96.0 (67-128)
Percent bladder capacity [MCC/ EBC]	117.5 (92.8-159.8)	90.0 (74.8-130.8)
DLPP or EFP (cmH2O)	22.5 (15.0 – 46.0)	20.0 (12.3 – 26.0)
Compliance (ml/cmH2O)	3.0 (1.7 – 5.6)	5.4 (3.5 - 7.9)

Table 2c. Main urodynamic features in the patients before and after exposure to mirabegron as alternative therapy to antimuscarinics for neurogenic bladder.

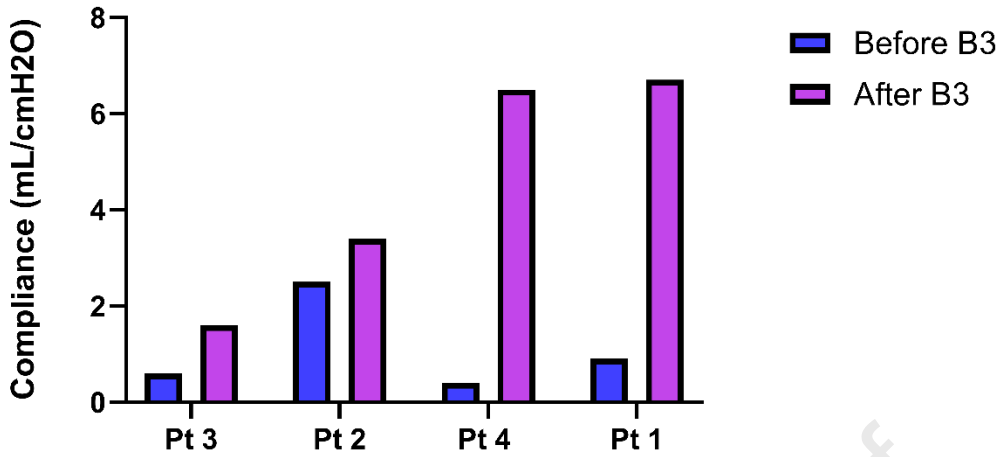

Figure 1a. Compliance by patient before and after exposure to mirabegron as primary therapy for neurogenic bladder (p=0.0969).

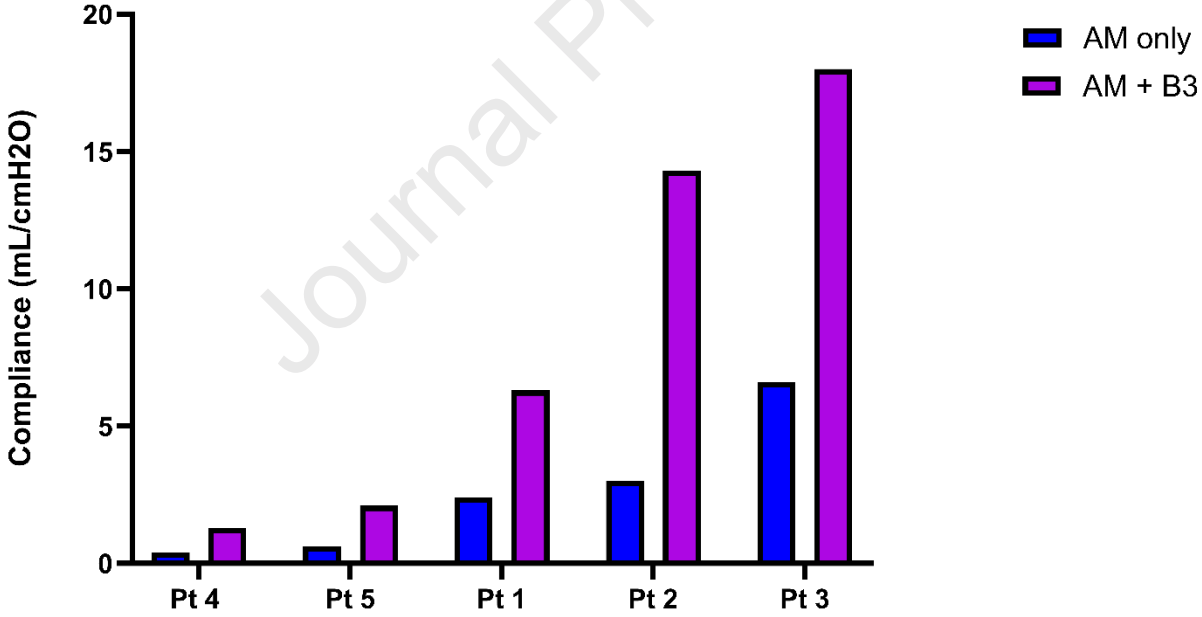

Figure 1b. Compliance by patient before and after exposure to mirabegron as adjuvant therapy combined with antimuscarinics for neurogenic bladder (p=0.0671).

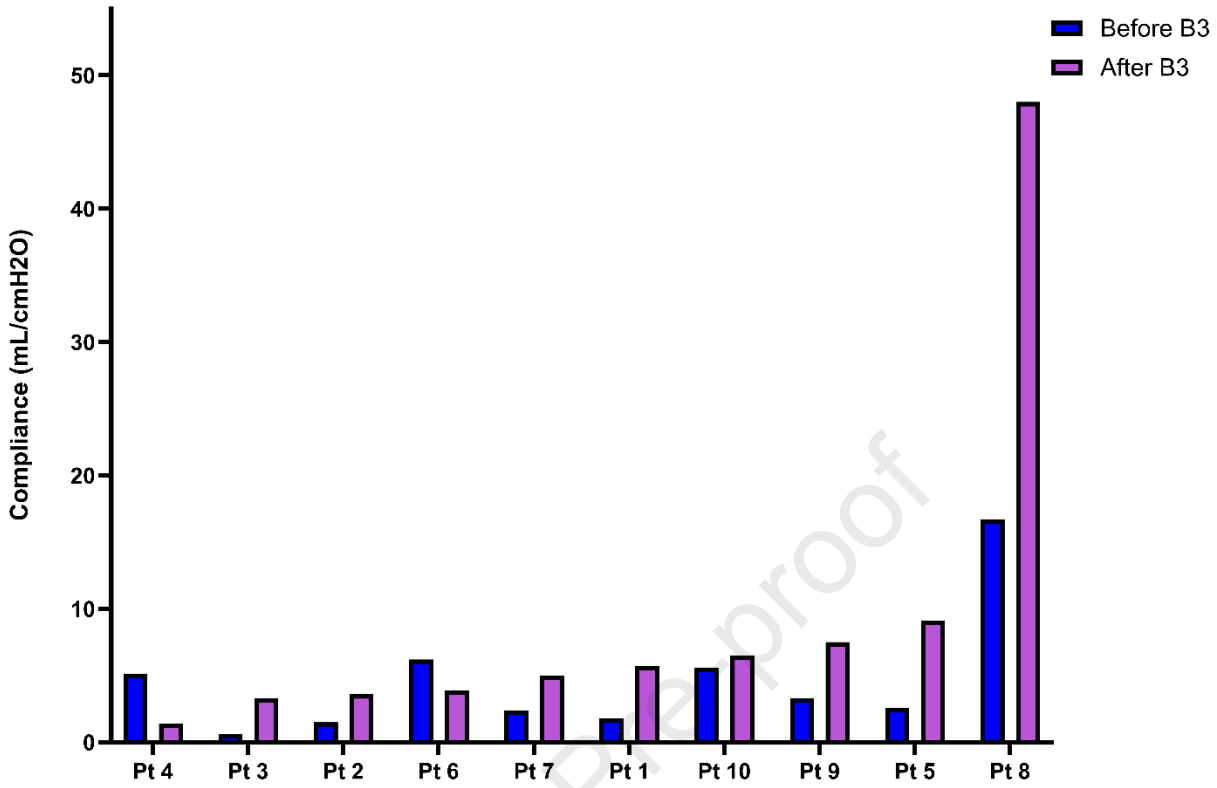

Figure 1c. Compliance by patient before and after exposure to mirabegron as alternative therapy to antimuscarinics for neurogenic bladder.

		UDS before B3	UDS after B3
Pt 1	CIC regimen	tid	qid
	Leakage b/t CIC	yes	yes
	%BC (max/EBC)	33%	200%
	Compliance value (ml/cmH2O)	0.9	6.7
	DLPP/EFP	32	27
	DO	yes	yes
Pt 2	CIC regimen	bid	bid + overnight
	Leakage b/t CIC	yes	yes
	%BC (max/EBC)	357%	263%
	Compliance value (ml/cmH2O)	2.5	3.4
	DLPP/EFP	67	42
	DO	no	yes
Pt 3	CIC regimen	weekly	bid
	Leakage b/t CIC	yes	yes
	%BC (max/EBC)	46%	56%
	Compliance value (ml/cmH2O)	0.6	1.6
	DLPP/EFP	40	26
	DO	yes	yes
Pt 4	CIC regimen	bid	tid
	Leakage b/t CIC	yes	yes
	%BC (max/EBC)	49%	214%
	Compliance value (ml/cmH2O)	0.4	6.5
	DLPP/EFP	112	30
	DO	yes	yes

Supplementary Table 1a. Breakdown of bladder urodynamics by patient before and after using mirabegron as primary pharmacotherapy for neurogenic bladder.

		UDS on AM monotherapy	UDS on AM + B3
Pt 1	CIC regimen	qid	tid + overnight
	Leakage b/t CIC	yes	no
	%BC (max/EBC)	189%	244%
	Compliance value (ml/cmH2O)	2.4	6.3
	DLPP/EFP	55	35
	DO	yes	yes
Pt 2	CIC regimen	qid	qid
	Leakage b/t CIC	yes	yes
	%BC (max/EBC)	126%	239%
	Compliance value (ml/cmH2O)	3.0	14.3
	DLPP/EFP	38	20
	DO	yes	yes
Pt 3	CIC regimen	qid + overnight	qid + overnight
	Leakage b/t CIC	yes	no
	%BC (max/EBC)	150%	100%
	Compliance value (ml/cmH2O)	6.6	18.0
	DLPP/EFP	20	5
	DO	yes	no
Pt 4	CIC regimen	tid + overnight	tid + overnight
	Leakage b/t CIC	yes	no
	%BC (max/EBC)	51%	63%
	Compliance value (ml/cmH2O)	0.4	1.3
	DLPP/EFP	132	72
	DO	yes	yes
Pt 5	CIC regimen	tid + overnight	qid + overnight
	Leakage b/t CIC	no	no
	%BC (max/EBC)	50%	178%
	Compliance value (ml/cmH2O)	0.6	2.1
	DLPP/EFP	75	76
	DO	yes	yes

Supplementary Table 1b. Breakdown of bladder urodynamics by patient before and after the addition of mirabegron to antimuscarinic pharmacotherapy for neurogenic bladder.

337

		UDS on AM therapy	UDS on alternative B3
Pt 1	CIC regimen	tid	tid + overnight
	Leakage b/t CIC	yes	yes
	%BC (max/EBC)	171%	100%
	Compliance value (ml/cmH2O)	1.8	5.7
	DLPP/EFP	80	21
	DO	no	no
Pt 2	CIC regimen	5 x	6 x
	Leakage b/t CIC	yes	yes
	%BC (max/EBC)	71%	77%
	Compliance value (ml/cmH2O)	1.5	3.6
	DLPP/EFP	44	35
	DO	no	no
Pt 3	CIC regimen	qid	qid
	Leakage b/t CIC	yes	yes
	%BC (max/EBC)	59%	78%
	Compliance value (ml/cmH2O)	0.6	3.3
	DLPP/EFP	86	20
	DO	yes	yes
Pt 4	CIC regimen	qid	qid
	Leakage b/t CIC	yes	yes
	%BC (max/EBC)	113%	63%
	Compliance value (ml/cmH2O)	5.1	1.4
	DLPP/EFP	20	53
	DO	yes	yes
Pt 5	CIC regimen	qid	qid
	Leakage b/t CIC	yes	yes
	%BC (max/EBC)	122%	98%
	Compliance value (ml/cmH2O)	2.6	9.1
	DLPP/EFP	52	13
	DO	no	no
Pt 6	CIC regimen	5 x	6 x
	Leakage b/t CIC	no	yes
	%BC (max/EBC)	102%	82%
	Compliance value (ml/cmH2O)	6.2	3.9
	DLPP/EFP	16	20
	DO	no	yes
Pt 7	CIC regimen	6 x	6 x
	Leakage b/t CIC	yes	yes
	%BC (max/EBC)	143%	68%
	Compliance value (ml/cmH2O)	2.4	5.0

	DLPP/EFP	38	10
	DO	no	yes
Pt 8	CIC regimen	qid	6 x
	Leakage b/t CIC	yes	no
	%BC (max/EBC)	238%	245%
	Compliance value (ml/cmH2O)	16.7	48.0
	DLPP/EFP	12	10
	DO	no	no
Pt 9	CIC regimen	tid	tid
	Leakage b/t CIC	yes	yes
	%BC (max/EBC)	100%	118%
	Compliance value (ml/cmH2O)	3.3	7.5
	DLPP/EFP	20	15
	DO	yes	yes
Pt 10	CIC regimen	bid	bid
	Leakage b/t CIC	yes	yes
	%BC (max/EBC)	156%	169%
	Compliance value (ml/cmH2O)	5.6	6.5
	DLPP/EFP	25	23
	DO	yes	yes

Supplementary Table 1c. Breakdown of bladder urodynamics by patient before and after the use of mirabegron as alternative to antimuscarinic pharmacotherapy for neurogenic bladder.

Patient	Baseline BP	Post Mirabegron BP	Second Post Mirabegron BP
1	122/82	88/62	
2	107/67	88/54	
3	132/116	110/65	96/65
4	99/47	90/60	
5	86/53	109/57	
6	127/71	114/64	
7	98/59	102/68	
8	127/79	82/54	
9	90/59		
10	97/81	108/60	100/41
11	102/60	104/79	82/53
12	100/61	101/74	
13	105/63	98/64	
14	98/52	78/46	
15	113/65	100/58	
16	115/69	106/69	101/66
17	110/67	114/70	
18	121/93		
19	122/72	97/52	130/71

Supplementary Table 2. Baseline and post mirabegron initiation blood pressure vaues individually reported.

Conflicts of interest: The authors have no conflicts of interest to report.

Funding source: No funding has been received for this study.

References:

1. Edwards, A.B. and M. Jacobs, *Early Vs. Expectant Management of Spina Bifida Patients-Are We All Talking About a Risk Stratified Approach?* Curr Urol Rep, 2019. **20**(11): p. 76.
2. Edelstein, R.A., et al., *The long-term urological response of neonates with myelodysplasia treated proactively with intermittent catheterization and anticholinergic therapy.* J Urol, 1995. **154**(4): p. 1500-4.
3. DeLair, S.M., et al., *Renal cortical deterioration in children with spinal dysraphism: analysis of risk factors.* J Spinal Cord Med, 2007. **30 Suppl 1**(Suppl 1): p. S30-4.
4. Stein, R., et al., *EAU/ESPU guidelines on the management of neurogenic bladder in children and adolescent part I diagnostics and conservative treatment.* Neurourol Urodyn, 2020. **39**(1): p. 45-57.
5. Adzick, N.S., et al., *A randomized trial of prenatal versus postnatal repair of myelomeningocele.* N Engl J Med, 2011. **364**(11): p. 993-1004.
6. Rawashdeh, Y.F., et al., *International Children's Continence Society's recommendations for therapeutic intervention in congenital neuropathic bladder and bowel dysfunction in children.* Neurourol Urodyn, 2012. **31**(5): p. 615-20.
7. Chua, M.E., et al., *2023 Canadian Urological Association/Pediatric Urologists of Canada guideline: Pediatric patients with neurogenic lower urinary tract dysfunction Full-text version.* Can Urol Assoc J, 2023. **17**(10): p. E338-E357.
8. Taylor-Rowan, M., et al., *Anticholinergic burden (prognostic factor) for prediction of dementia or cognitive decline in older adults with no known cognitive syndrome.* Cochrane Database Syst Rev, 2021. **5**(5): p. CD013540.
9. Pieper, N.T., et al., *Anticholinergic drugs and incident dementia, mild cognitive impairment and cognitive decline: a meta-analysis.* Age Ageing, 2020. **49**(6): p. 939-947.
10. Ghezzi, E., et al., *The effects of anticholinergic medications on cognition in children: a systematic review and meta-analysis.* Sci Rep, 2021. **11**(1): p. 219.
11. Stein, R., et al., *EAU/ESPU guidelines on the management of neurogenic bladder in children and adolescent part II operative management.* Neurourol Urodyn, 2020. **39**(2): p. 498-506.
12. Keam, S.J., *Mirabegron: Pediatric First Approval.* Paediatr Drugs, 2021. **23**(4): p. 411-415.
13. Bauer, S.B., et al., *International Children's Continence Society standardization report on urodynamic studies of the lower urinary tract in children.* Neurourol Urodyn, 2015. **34**(7): p. 640-7.
14. Austin, P.F., et al., *The standardization of terminology of lower urinary tract function in children and adolescents: Update report from the standardization committee of the International Children's Continence Society.* Neurourol Urodyn, 2016. **35**(4): p. 471-81.
15. Franco, I., et al., *A quantitative approach to the interpretation of uroflowmetry in children.* Neurourol Urodyn, 2016. **35**(7): p. 836-46.
16. Gaines, T., et al., *Mirabegron as part of combination therapy for treatment refractory neurogenic bladder in pediatric patients with spina bifida.* J Pediatr Urol, 2025.

17. Taghizadeh, A.K., et al., *Long-term efficacy of Mirabegron-anticholinergic combination in paediatric neurogenic bladder.* J Pediatr Urol, 2025. **21**(2): p. 303-309.
18. Sager, C., et al., *Efficacy and safety of Mirabegron as adjuvant treatment in children with refractory neurogenic bladder dysfunction.* J Pediatr Urol, 2020. **16**(5): p. 655 e1-655 e6.
19. Welk, B., *The impact of anticholinergics on cognitive function in patients with neurogenic lower urinary tract dysfunction: A narrative review.* Indian J Urol, 2024. **40**(2): p. 82-87.
20. Franco, I., et al., *Long-term efficacy and safety of solifenacin in pediatric patients aged 6 months to 18 years with neurogenic detrusor overactivity: results from two phase 3 prospective open-label studies.* J Pediatr Urol, 2020. **16**(2): p. 180 e1-180 e8.
21. Kitta, T., et al., *Fesoterodine treatment of pediatric patients with neurogenic detrusor overactivity: A 24-week, randomized, open-label, phase 3 study.* J Pediatr Urol, 2023. **19**(2): p. 175 e1-175 e10.
22. Giramonti, K.M., B.A. Kogan, and L.F. Halpern, *The effects of anticholinergic drugs on attention span and short-term memory skills in children.* Neurourol Urodyn, 2008. **27**(4): p. 315-8.
23. Neveus, T., et al., *The standardization of terminology of lower urinary tract function in children and adolescents: report from the Standardisation Committee of the International Children's Continence Society.* J Urol, 2006. **176**(1): p. 314-24.