Spina Bifida Guideline

Urologic guidelines for the care and management of people with spina bifida

David B. Josepha,*, Michelle A. Baumb, Stacy T. Tanakac, Dominic C. Frimbergerd, Rosalia Missete, Rose Khavarif, Sharon Baillieg, Elizabeth B. Yerkesb and Hadley Woodi

aUniversity of Alabama at Birmingham, Children’s of Alabama, Birmingham, Alabama, USA
bBoston Children’s Hospital, Harvard Medical School, Boston, Massachusetts, USA
cVanderbilt University Medical Center, Nashville, Tennessee, USA
dChildren’s Hospital of Oklahoma, University of Oklahoma Health Science Center, Oklahoma City, Oklahoma, USA
eIndiana University School of Medicine, Riley Children’s Health, Indianapolis, Indiana, USA
fHouston Methodist Hospital, Houston, Texas, USA
gParaquad NSW, Newington, New South Wales, Australia
hAnn and Robert H. Lurie Children’s Hospital of Chicago, Northwestern University’s Feinberg School of Medicine, Chicago, Illinois, USA
iCleveland Clinic, Glickman Urologic and Kidney Institute, Cleveland, Ohio, USA

Abstract.

PURPOSE: The life expectancy for people with spina bifida has increased, thus resulting in greater need for guidelines in urologic care in order to protect normal renal function, to develop strategies for urinary continence, and to advance independence through adult years.

METHODS: The English literature was assessed from 2002–2015; greater than 300 publications identified. Case reports and opinion pieces were eliminated leaving 100 for in depth review. Clinical questions were then established for each age group that allowed for focused assessment.

RESULTS: There was no Level 1 evidence for any of the defined clinical questions. This resulted in group consensus for all questions throughout all age groups. Guidelines were provided for identifying a symptomatic urinary infection, the role of urodynamic bladder testing and identification of bladder hostility, determining methods of renal function assessment and surveillance, the initiation of continence control, and transitioning to self-care through the teen and adult years.

CONCLUSION: Urologic guidelines continue to be based on clinical consensus due to the lack of high level evidence-based research. Further research is required in all aspects of urologic management. While not the “Standard of Care,” these guidelines should be considered “Best Practice”.

Keywords: Spina bifida, spinal dysraphism, neurogenic bladder, myelomeningocele, neural tube defects

1. Introduction

As life expectancy in people with spina bifida has increased through advances in care by other disciplines, particularly neurosurgery, urologic morbidity and mortality have become problematic for all individuals progressing into adulthood. This places the importance of...
developing guidelines for care that will enhance urologic management of individuals with spina bifida into perspective. These guidelines focus on maintaining normal renal function through all ages, developing strategies for urinary continence, and achieving the highest level of independence with personal care through adulthood.

The majority of newborns with spina bifida have a normal upper urinary tract (kidney and ureter). Tanaka et al. reported on 188 infants with two kidneys; only 3.7% had high grade hydronephrosis in at least one kidney, 40.4% had low grade hydroureter in at least one kidney and 55.9% had two normal kidneys, 84.6% of infants had no reflux. Of the 66 infants who were able to obtain a dimercaptosuccinic acid (DMSA) scan, only 5 infants had defects noted on the scan [1]. Historically, we know that if left unattended, 50% of children will suffer upper urinary tract damage within 5 years due to lower urinary tract (bladder and urethra) hostility [2]. During the first several years of life, the urologic focus on a child’s health is based on maintaining normal renal function at a time when the kidneys are most susceptible to damage. As the child approaches school age, interest is extended toward gaining urinary continence. Then, structured transition to self-care begins for teenage patients. Each of these urologic management milestones builds upon the last and may influence renal function in a positive or negative fashion.

The importance of maintaining normal renal function cannot be overstated. While creatinine is a good screening estimate of renal function, it is limited in the non-ambulatory child and adult with spina bifida due to low muscle mass and may provide a false sense of normality [3]. Renal function may be more accurately measured with serum cystatin C or with a nuclear medicine estimated glomerular filtration rate test (GFR) [4]. Currently, the best measure of renal function in children and adults with spina bifida is unknown.

This urologic guideline is aspirational and merges aspects of proactive and reactive philosophies based on “best practice” methodology utilizing common resources available within most institutional settings. The guideline was developed by adult and pediatric experts with the intent to assist clinicians, patients, families and other stakeholders to achieve the Primary, Secondary and Tertiary urologic outcomes that provided the foundation for its development. Urologic care is appreciated to be dynamic and ever changing.

1.1. Outcomes

Primary

1. Maintain normal renal function throughout the lifespan.
2. Achieve urinary continence as early as socially acceptable.
3. Maximize urologic independence.

Secondary

1. Eliminate hostile bladder dynamics through medical management.
2. Reduce or eliminate operative reconstruction of the bladder.
3. Maximize renal outcome while minimizing expense of studies, staying aware of the timing and frequency of studies such as urodynamic testing, upper tract imaging, and lab studies.
4. Reduce impact of urinary tract infections (UTIs) and antibiotic overuse.
5. Establish a care program that allows for urologic independence, such as through clean intermittent self-catheterization (self-CIC).

Tertiary

1. Determine the best measure of renal function.
2. Minimize occurrence of urolithiasis.
3. Determine whether surgical interventions are effective in the long-term.

2. Methods

These guidelines were developed through literature review and consensus-building methodology as described by Dicianno et al. [5] Phase 1 initiated the preparation phase with the establishment of the working group and dividing expertise into content areas. All authors participated extensively in this process. Phase 2 focused on review of the literature. The prior Guide- line 3rd edition was published in 2006 with literature reviewed from mid-1970s through 2002 and did not include adults. The current guidelines are based on English language, peer-reviewed literature from 2002–2015. Clinical questions were developed for each age group in order to provide focused guidance on the assessment of evidence-based research (Table 1). After eliminating case studies and opinion pieces, the working group assessed over 300 articles, identifying approximately 100 that met criteria for review. Within that group of articles, the lack of evidence-based research created gaps requiring focus on clinical consensus for each recommendation. Phase 3 finalized the guideline development utilizing consensus building methodology. Consensus was defined as overwhelming agreement
but not unanimity within the working group. This provided the foundation for the urologic guidelines recommended within the 2018 Spina Bifida Association Guidelines for the Care of People with Spina Bifida [6].

3. Results

While there is a plethora of peer reviewed urologic information, none support Level 1 clinical evidence related to the defined clinical questions. The following guidelines were based on working group consensus. Guidelines in each age group correspond to the clinical questions established for that time period (Table 1). The process that established each guideline along with any supporting literature is indicated in the parentheses (i.e., clinical consensus [5]) Guidelines by age are found in Table 2.

4. Discussion

These guidelines were created to assist care providers across disciplines with the basic requirements to maintain normal renal function, establish continence that would be considered socially acceptable, and ultimately allow for transition to self-care. Overarching goals for all guidelines across disciplines was to focus care coordination in a patient- and family-centered fashion and to develop a medical home and neighborhood founded on team-based care.

Institutions create protocols for care based on their philosophy and available resources. Two general philosophies of early urologic management prevail: a proactive approach and a reactive approach. The proactive approach attempts to identify children at risk for upper urinary tract deterioration based on specific hostile parameters. Treatment is initiated before renal compromise occurs. The reactive approach follows a child closely and institutes management at the first sign of any adverse change [7,9,12]. Advocates of a proactive approach favor early identification of “at risk” children by assessing bladder function through urodynamic testing and managing hostile bladder parameters. This is undertaken to prevent adverse upper urinary tract
Table 2
Urologic guidelines by age

| Age          | Guideline                                                                                                                                                                                                 | Evidence                                                                 |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| 0–11 months  | 1. Obtain the following baseline studies within three months of birth:                                                                                                                                   | Clinical consensus [7]                                                   |
|              |   - Renal/bladder ultrasound and repeat in six months                                                                                                                                                |                                                                          |
|              |   - Urodynamic testing                                                                                                                                                                               |                                                                          |
|              |   - Serum creatinine                                                                                                                                                                                 |                                                                          |
|              | 2. Initiate CIC and antimuscarinic therapy for the treatment of bladder hostility when indicated based on the above results.                                                                         | Clinical consensus [7]                                                   |
|              | 3. Consider the presence of a Urinary Tract Infection (UTI)∗ when there is a fever (100.4 F/38.0 C) in neonates less than one month of age with failure to thrive and dehydration. |                                                                          |
| 1–2 years    | 1. Obtain renal/bladder ultrasound every six months when the child is under the age of two. Next, obtain an ultrasound yearly if the child is stable, without UTIs or imaging changes. | Clinical consensus                                                      |
| 11 months    | 2. Obtain a renal/bladder ultrasound, as needed if the child has recurring symptomatic UTIs or if urodynamic testing identifies bladder hostility.                                                           | Clinical consensus                                                      |
|              | 3. Obtain urodynamic testing yearly through age three. Repeat as needed if the following are noted:                                                                                                    | Clinical consensus [2,9,10]                                               |
|              |   - bladder hostility                                                                                                                                                                                |                                                                          |
|              |   - upper urinary tract changes                                                                                                                                                                         |                                                                          |
|              |   - recurrent symptomatic UTIs                                                                                                                                                                          |                                                                          |
|              | 4. Obtain a serum creatinine test if there is a change in the upper urinary tract.                                                                                                                     | Clinical consensus                                                      |
|              | 5. Assess suspected UTIs with a urine specimen obtained by sterile catheterization technique. Repeat a positive bag urine specimen with a catheterized specimen.                                            | Clinical consensus                                                      |
| 3–5 years    | 1. Obtain a renal/bladder ultrasound yearly, if the child is stable.                                                                                                                                  | Clinical consensus                                                      |
| 11 months    | 2. Obtain a renal/bladder ultrasound as needed, if the child has recurrent symptomatic UTIs or if urodynamic testing identifies bladder hostility.                                                           | Clinical consensus                                                      |
|              | 3. Obtain urodynamic testing only if the following are present:                                                                                                                                    | Clinical consensus                                                      |
|              |   - upper tract changes                                                                                                                                                                                |                                                                          |
|              |   - recurring UTIs                                                                                                                                                                                    |                                                                          |
|              |   - interest in beginning a urinary continence program                                                                                                                                                 |                                                                          |
|              | 4. If the child is on CIC, begin to involve the child in the process of self-catheterization.                                                                                                          | Clinical consensus [11]                                                  |
|              | 5. Obtain a serum creatinine test if there is a change in imaging of the upper urinary tract.                                                                                                           | Clinical consensus                                                      |
|              | 6. Obtain serum chemistries (includes serum creatinine) at age 5. Assess suspected UTIs with a catheterized urine specimen. Repeat a positive bag urine specimen with a catheterized specimen. | Clinical consensus                                                      |
|              | 7. Initiate CIC and antimuscarinic therapy when indicated by upper urinary tract changes, recurring symptomatic UTIs, or bladder hostility noted on urodynamic testing.                                   | Clinical consensus [7,9,12]                                              |
|              | 8. Introduce urinary continence and discuss interest in beginning the program and options at each visit.                                                                                               | Clinical consensus [11,13]                                               |
|              | 9. Introduce bowel management and discuss interest and discuss interest and options at each visit.                                                                                                     | Clinical consensus                                                      |
| 6–12 years   | 1. Obtain a renal/bladder ultrasound yearly, if the child is stable.                                                                                                                                   | Clinical consensus                                                      |
| 11 months    | 2. Obtain a renal/bladder ultrasound as needed if the child has recurrent symptomatic UTIs or if urodynamic testing identifies bladder hostility.                                                           | Clinical consensus                                                      |
|              | 3. Obtain urodynamic testing when initiating a urinary continence program, if the following are present:                                                                                               | Clinical consensus                                                      |
|              |   - upper urinary tract changes such as hydronephrosis or renal scarring                                                                                                                                |                                                                          |
|              |   - recurring symptomatic UTIs                                                                                                                                                                          |                                                                          |
|              |   - changes in urinary continence status                                                                                                                                                                |                                                                          |
|              | 4. Obtain a serum creatinine test yearly. If the child has low muscle mass, consider an alternative measure of renal function.                                                                         | Clinical consensus [3]                                                  |
|              | 5. Obtain serum chemistries yearly on any child who has had urinary reconstruction.                                                                                                                  | Clinical consensus [14–16]                                               |
|              | 6. Obtain a serum B12 level test every year beginning two years after urinary reconstruction.                                                                                                            | Clinical consensus [11,13]                                               |
|              | 7. Discuss a urinary continence program and interest in beginning the program and options at each visit.                                                                                               | Clinical consensus                                                      |
|              | 8. Discuss a bowel management program and the interest and options at each visit.                                                                                                                     | Clinical consensus [11,13]                                               |
| 13–17 years  | 1. Obtain a renal/bladder ultrasound yearly, if the child is stable.                                                                                                                                  | Clinical consensus                                                      |
| 11 months    | 2. Obtain a renal/bladder ultrasound as needed, if the child has recurring symptomatic UTIs or if urodynamic testing identifies bladder hostility.                                                           | Clinical consensus                                                      |
|              | 3. Obtain a serum creatinine test yearly. If the child has low muscle mass, consider an alternative measure of renal function.                                                                         | Clinical consensus [3]                                                  |
|              | 4. Obtain serum chemistries including B12 yearly on any child who has had urinary reconstruction.                                                                                                | Clinical consensus [14–16]                                               |
|              | 5. Transition urologic care to self-management, if doing so is developmentally appropriate for the child.                                                                                              | Clinical consensus [17,18]                                              |
### Table 2, continued

| Age         | Guideline                                                                                                           | Evidence                      |
|-------------|---------------------------------------------------------------------------------------------------------------------|-------------------------------|
| 13–17 years | 6. Transition bowel program to self-management, if doing so is developmentally appropriate for the child.          | Clinical consensus             |
| 11 months   | 1. Obtain a renal/bladder ultrasound yearly.                                                                        | Clinical consensus             |
| 18+ years   | 2. Obtain a renal/bladder ultrasound, as needed if the adult has recurring symptomatic UTIs or if urodynamic testing identifies bladder hostility. | Clinical consensus             |
|             | 3. Obtain a serum creatinine test yearly. If the adult has low muscle mass, consider an alternative measure of renal function. | Clinical consensus [3]         |
|             | 4. Obtain serum chemistries including B12 yearly on anyone who has had urinary reconstruction.                      | Clinical consensus [14–16]     |
|             | 5. Undertake cystoscopy and appropriate upper tract imaging in adults who have had a bladder augmentation when the following are present: | Clinical consensus [19–21]     |
|             | - clinically-noted change in upper or lower urinary tract status                                                   |                               |
|             | - gross hematuria                                                                                                    |                               |
|             | - recurrent symptomatic UTIs                                                                                         |                               |
|             | - increasing incontinence                                                                                           |                               |
|             | - pelvic pain                                                                                                       |                               |
|             | - the adult has had a renal transplant with the presence of BK/polyomavirus                                         |                               |
|             | 6. Evaluate patterns of continence/incontinence and address issues collaboratively with the individual and family. | Clinical consensus [22]       |
|             | Include assessment of amount (volume) of incontinence as the volume in adults may be more bothersome than frequency. |                               |
|             | 7. Continue to support self-management and independent living.                                                      | Clinical consensus             |

*The working group recognized the lack of consistency with defining a symptomatic UTI, positive UA and urine culture. This is a critical management parameter for each age group. Therefore, the working group utilized the recommendation by Madden-Fuentes et al. regarding a symptomatic UTI in the spina bifida population [8]. Urinary Tract Infection:

- a positive UA, and
- a positive urine culture (UC) on a catheterized specimen, and
- leakage between CIC, and
- onset of pelvic or back pain, and
- fever (100.4 F/38.0 C).

Positive UA (+UA):

- > trace nitrite or leukocyte esterase on dip UA, and
- > 10 white blood cells/high power field (WBCs/hpf), uncentrifuged specimen, or
- > 5 WBCs/hpf, centrifuged specimen.

Positive UC (+UC) as:

- > 50,000 colony forming units/milliliter (CFUs/mL) (sterile specimen obtained by catheter or suprapubic catheter aspirate).
- > 100,000 CFUs/mL in a clean voided specimen [8].

Changes and preserve normal renal function, thus minimizing possible irreversible upper tract deterioration. It is known that some individuals will be subjected to the consequences of intervention that were unnecessary, exposing them to associated risks, and may needlessly utilize resources. Institutions favoring a reactive approach rely on close evaluation of the upper urinary tract, renal function, and documentation of urinary infections. They feel adverse upper urinary tract changes and renal compromise can be detected early utilizing minimally invasive assessment, renal ultrasonography, and assessing renal function parameters with a serum renal function study. Adverse changes are assumed to be reversed with medical, pharmacologic, and operative management. This approach involves treating children reactively, “as needed,” and allows for a more precise selective management model limiting the stress and potential side effects of invasive procedures, medications, catheterization, and surgery. However, it is not known if all adverse renal changes noted on ultrasonography can be reversed, and if current renal function studies, particularly serum creatinine, truly reflect the renal status in patients with spina bifida. The urologic guidelines merge aspects of both proactive and reactive management.

People with spina bifida are at risk for progressive renal damage secondary to recurrent urinary tract infections and a hostile neurogenic bladder. Bladder hostility may result in upper urinary tract deterioration, hydronephrosis, recurrent pyelonephritis and renal scarring. Some patients may progress to end stage renal disease requiring dialysis or renal transplantation [23,24]. Infants with spina bifida demonstrate overall normal baseline imaging (including renal US and baseline DMSA) [1]. Hence management of bladder function to prevent adverse upper urinary tract changes to preserve renal function is critical [1,25].
Establishing guidelines to follow evidence-based management is logical. In 2003, sponsors from the NIH, CDC and SBA convened a conference of 100 authorities across multiple disciplines tasked with creating a research agenda for spina bifida based on what was known and lacking in evidence-based care [26]. Universally, evidence-based management was found to be lacking. Directives in 2003 were provided to help position research that would enhance the level of care based on sound evidence. Those goals had not been achieved through 2015 when work began on these guidelines. Therefore, the guidelines remain by consensus and they are not meant to represent a standard of care.

It is important to understand that these guidelines remain primarily a tool for assessment. Clearly, direction is lacking regarding treatment related to a medical, pharmaceutical, or surgical intervention. Diversity in patient population, regional differences, institutional resources, and local urologic philosophy all play a role in care and prevented the working group from establishing a consensus.

“Clinical questions” were the driving metric used to establish the guidelines. A prevailing question within all age groups was related to urinary tract infections. Our intent was to support a common definition for a urinary tract infection based on symptoms along with objective urinalysis and culture of urine that could be maintained throughout the lifespan. We identified the work of Madden-Fuentes et al. as the most relevant and reflective definition [8]. It is appreciated that intermittent catheterization and other clinical symptoms (abdominal pain, new onset of leakage, etc.) may be additional guiding factors when assessing a positive urine culture. Identifying what truly is a symptomatic urinary tract infection requiring treatment allows for early judicious antibiotic therapy, and hopefully will reduce the cycle of overtreatment asymptomatic bacteriuria.

The underlying goal of the urologic guidelines is to maintain normal renal function starting from birth. The glaring absence of evidence-based care of newborns, toddlers and young children prompted the CDC to develop a management protocol [27]. Now recognized as UMPIRE (urologic management to preserve initial renal function), the longitudinal protocol was established in 2014 at 9 centers throughout the United States following children from birth through the age of 5 years [25]. This is an iterative quality improvement consensus-based protocol utilizing prospective treatment. Outcomes are routinely assessed based on evidence with adjustments made to optimize care. UMPIRE has primary outcomes focused on urinary tract infection, renal function and bladder characteristics. The role of urodynamic testing is critical to the protocol. The appreciation of nuances related to testing and interpretation has already impacted the standardization of technical aspects of the procedure and objective identification of common urodynamic parameters (i.e., detrusor over activity, detrusor leak point pressure, end fill pressure, detrusor-sphincter-dyssynergy). The CDC has recently extended UMPIRE through 10 years of age. It is envisioned that UMPIRE will provide the lacking evidence to support proactive care.

The foundation of all urologic care is based on maintaining normal renal function, and increased monitoring in people with spina bifida is also one of the guideline goals. We appreciate that a significant deficiency exists within these guidelines regarding the establishment of objective renal function. The Kidney Disease Improving Global Outcomes (KDIGO) 2012 Clinical Practice Guideline for the evaluation and management of chronic kidney disease emphasizes the importance of assessing renal function in all patients with chronic kidney disease [28], which is defined as abnormalities of kidney structure or function present for greater than 3 months. Chu et al. suggest that providers are not assessing kidney function in most practices in the spina bifida registry [29].

Currently, there is no consensus on how to best monitor for renal function in children with spina bifida. The UMPIRE study will be assessing serial radiologic imaging studies, urodynamics, renal scarring by DMSA renal scan and various measures of GFR over time [1,25]. KDIGO guidelines suggest using serum creatinine and a GFR estimating equation (eGFR) for initial assessment, with additional tests such as cystatin C or clearance measurement for confirmatory testing in circumstances when eGFR based on serum creatinine is less accurate. Formulas to calculate eGFR, including Schwartz formula, 2012 CKD-EPI cystatin C formula and CKD-EPI creatinine-cystatin C equation, and alternate cystatin C based GFR equations, are found in the KDIGO guideline paper [28].

In patients with spina bifida, creatinine is a poor marker of eGFR due to low muscle mass, particularly those who are non-ambulatory. This was initially suggested in 1997 by Quan et al., where authors described poor correlation with diethylenetriamine pentaacetaete (DTPA) eGFR and the creatinine based Schwartz formula [30]. In addition, creatinine based Schwartz formulas required an accurate height measurement, which can be difficult to obtain in many non-ambulatory patients with spina bifida. Cystatin C, another marker of
renal function, is a protein produced at a constant rate by all nucleated cells. It is freely filtered by the glomerulus and not secreted at the renal tubule and is nearly entirely catabolized within the proximal tubule [31,32]. Several small studies have suggested that cystatin C based eGFR equations may be better in patients with spina bifida. Clearance studies have been considered the gold standard. They require injection of a substance with multiple timed blood draws. Inulin clearance may be the most accurate, but has limited availability [33]. Iohexol, 51-cr-EDTA and 99Tc-DTPA are also options, but require body surface area calculations to give GFR in ml/min/1.73m² that require accurate weight and height measurements. Lastly, Zappitelli et al. developed a specific spina bifida formula which was studied in a small cohort and also assessed recently in a single center study [29,31]. Variability in assessment of eGFR in children and adults based on the formula used has been reported [34].

Urinary continence increasingly becomes relevant as children age into adolescence, the teen years, and adult life [35]. It impairs quality of life, ability to function in school and work, and increasingly impacts health quality with aging [36]. For many people with spina bifida, attaining continence requires engagement of the patient and family members. A dedication to self-management skills and careful decision-making with the urologic team regarding the need for and timing of interventions must be established. Nursing support and education for the patient and family before and after continence procedures must be expected. The guidelines recommend that discussions are initiated early in childhood and continue through adult life. It is well documented that continence is not stable throughout the lifespan and declines in adult life in people with spina bifida as well as the general population. Regular discussion with urologic providers related to urinary incontinence episodes, complications associated with leakage, and patient bother is recommended [37,38]. Data are lacking regarding the optimal definition of continence in patients with spina bifida. However, studies suggest that volume and frequency of leakage events is proportional to quality of life impact [39]. Therefore, patients should be evaluated annually for both frequency and quantity (volume) of leakage events, occurrence of skin breakdown associated with urinary incontinence, and bother associated with urinary incontinence. The goals for continence should be discussed regularly with the urological care team.

The increased lifespan of patients with spina bifida awakened the medical community about the importance and urgent need of transitioning care from the caregiver to young adult, and from the pediatric Urologist to the adult Urologist. Several transition programs have been introduced throughout the nation that focus on educating the young adults about their disease and need for lifelong medical management [40,41]. Equally important is the involvement of the adult providers in the often-complicated care of these patients as they leave pediatric practices. Transition programs focus on involving the patients and their families in achieving maximal independence and comfort within the adult medical system with the major goal of maintaining compliance with follow up to avert preventable long-term problems.

It has been noted that the primary limitation with these guidelines is the fact they are not directed by evidence-based practice. The small patient population within individual spina bifida centers and the inability to create prospective randomized trials with control groups that withhold care prevents establishment of evidence-based recommendations. Moving forward, multi-institutional assessments and studies (e.g. UMPIRE) will be needed for greater direction in objective care. The CDC’s National Spina Bifida Patient Registry provides a platform to collate patient data in a standardized fashion in hopes of ratifying best practice methodologies [42]. Adding to that, a standardized approach to urologic assessment as these Guidelines provide, should help limit some of the common variables that exist between centers.

5. Conclusion

The urologic guidelines were developed on a platform of clinical questions based on age. The lack of evidence-based studies necessitated our utilization of consensus opinion in order to direct care surrounding our clinical questions. This sheds light on the major gaps in urologic clinical care that need further research. While not the “Standard of Care,” there is justification for utilizing these guidelines as “Best Practice.”

Acknowledgments

This edition of the Journal of Pediatric Rehabilitation Medicine includes manuscripts based on the most recent “Guidelines For the Care of People with Spina Bifida,” developed by the Spina Bifida Association. Thank you to the Spina Bifida Association for allowing the
guidelines to be published in this forum and making them Open Access.

The Spina Bifida Association has already embarked on a systematic process for reviewing and updating the guidelines. Future guidelines updates will be made available as they are completed.

Executive Committee

- Timothy J. Brei, MD, Spina Bifida Association Medical Director; Developmental Pediatrician, Professor, Seattle Children’s Hospital
- Sara Struwe, MPA, Spina Bifida Association President & Chief Executive Officer
- Patricia Beierwaltes, DPN, CPNP, Guideline Steering Committee Co-Chair; Assistant Professor, Nursing, Minnesota State University, Mankato
- Brad E. Dicianno, MD, Guideline Steering Committee Co-Chair; Associate Medical Director and Chair of Spina Bifida Association’s Professional Advisory Council; Associate Professor, Department of Physical Medicine and Rehabilitation, University of Pittsburgh School of Medicine
- Nienke Dosa MD, MPH, Guideline Steering Committee Co-Chair; Upstate Foundation Professor of Child Health Policy; SUNY Upstate Medical University
- Lisa Raman, RN, MScANP, MEd, former Spina Bifida Association Director, Patient and Clinical Services
- Jerome B. Chelliah, MD, MPH, Johns Hopkins Bloomberg School of Public Health

Additional Acknowledgements

- Julie Bolen, PhD, MPH, Lead Health Scientist, Rare Disorders Health Outcomes Team, National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention
- Adrienne Herron, PhD Behavioral Scientist, Intervention Research Team, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, Centers for Disease Control and Prevention
- Judy Thibudeau, RN, MN, Spina Bifida Association Director, Research and Services; former Health Scientist, National Spina Bifida Program, National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention

Funding

The development of these Guidelines was supported in part by Cooperative Agreement U01DD001077, funded by the Centers for Disease Control and Prevention. Its contents are solely the responsibility of the authors and do not necessarily represent the official view of the Centers for Disease Control and Prevention or the Department of Health and Human Services.

Conflict of interest

David Joseph is a Principal Investigator at UAB/Children’s of Alabama for the CDC protocols: Component B-Improving the Care and Outcomes of People Living with SB-National Spina Bifida Patient Registry U01DD001237-02; Component C-Research Approaches to Improve the Care and Outcomes of People Living with Spina Bifida- (UMPIRE) U01DD001236-02.

The other authors have no conflicts of interest to report.

References

[1] Tanaka ST, Paramsothy P, Thibudeau J, Wiener JS, Joseph DB, Cheng EY, et al. Baseline urinary imaging in infants enrolled in Urologic Management to Preserve Initial Renal Function (UMPIRE) protocol for children with spina bifida. J Urol. 2019 Jun; 201(6): 1193–1198. doi: 10.1097/JU.0000000000001411.
[2] Bauer SB, Joseph DB. Management of the obstructed urinary tract associated with neurogenic bladder dysfunction. Urol Clin North Am. 1990 May; 17(2): 395–406.
[3] Quan A, Adams R, Ekmark E, Baum M. Serum creatinine is a poor marker of glomerular filtration rate in patients with spina bifida. Dev Med Child Neurol. 1997 Dec; 39(12): 808–10. doi: 10.1111/j.1469-8749.1997.tb07547.x.
[4] Kidney Disease: Improving Global Outcomes (KDIGO) CKD-MBD Work Group. KDIGO clinical practice guideline for the diagnosis, evaluation, prevention, and treatment of Chronic Kidney Disease-Mineral and Bone Disorder (CKD-MBD). Kidney Int Suppl. 2009 Aug; (113): S1–130. doi: 10.1038/ki.2009.188.
[5] Dicianno BE, Beierwaltes P, Dosa N, Raman L, Chelliah J, Struwe S, et al. Scientific methodology of the development of the guidelines for the care of people with spina bifida: an initiative of the Spina Bifida Association. Disabil Health J. 2020 Apr; 13(2): 100816. doi: 10.1016/j.dhjo.2019.06.005.
[6] Spina Bifida Association. Guidelines for the care of people with spina bifida. 2018. https://www.spinabifidaaassociation.org/guidelines/.
[7] Edelstein RA, Bauer SB, Kelly MD, Darney MM, Peters CA, Atala A, et al. The long-term urological response of neonates with myelodysplasia treated proactively with intermittent catheterization and anticholinergic therapy. J Urol. 1995 Oct; 154(4): 1500–4.
[8] Madden-Fuentes RJ, McNamara ER, Lloyd JC, Wiener JS, Routh JC, Seed PC, et al. Variation in definitions of urinary tract infections in spina bifida patients: a systematic review. Pediatrics. 2013 Jul; 132(1): 132–9. doi: 10.1542/peds.2013-0557.
Ouyang L, Bolen J, Hoshbin S, Lebowitz RL, Winston KR, Gibson S, et al. Predictive value of urodynamic evaluation in newborns with myelodysplasia. JAMA. 1984 Aug 3; 252(5): 650–2.

Routh JC, Cheng EY, Austin JC, Baum MA, Gargollo PC, Grady RW, et al. Design and methodological considerations of the centers for disease control and prevention urologic and renal protocol for the newborn and young child with spina bifida. J Urol. 2016 Dec; 196(6): 1728–1734. doi: 10.1016/j.juro.2016.07.081.

Edwards M, Borzyskowski M, Cox A, Badcock J. Neuropathic bladder and intermittent catheterization: social and psychological impact on children and adolescents. Dev Med Child Neurol. 2004 Mar; 46(3): 168–77. doi: 10.1017/s0022229995862256.

Hoppes CV, Kropp KA. Preservation of renal function in children with myelomeningocele managed with basic newborn evaluation and close followup. J Urol. 2003 Jan; 169(1): 305–8. doi: 10.1016/s0022-5347(17)36049-4.

Moore C, Kogan BA, Badcock J. Impact of urinary incontinence on self-concept in children with spina bifida. J Urol. 2004 Apr; 171(4): 1659–62. doi: 10.1016/s0022-5347(17)36049-4.

Ganesan T, Khadra MH, Wallis J, Neal DE. Vitamin B12 malabsorption following bladder reconstruction or diversion with bowel segments. ANZ J Surg. 2002 Jul; 72(7): 479–82. doi: 10.1046/j.1445-2197.2002.02460.x.

Steiner MS, Morton RA, Marshall FF. Vitamin B12 deficiency in patients with ileocoeicol neobladders. J Urol. 1993 Feb; 149(2): 255–7. doi: 10.1016/0022-5371(93)90004-d.

Fujisawa M, Gotoh A, Nakamura I, Hara IS, Okada H, Yamanaka N, et al. Long-term assessment of serum vitamin B(12) concentrations in patients with various types of orthotopic intestinal neobladder. Urology. 2000 Aug 1; 56(2): 236–40. doi: 10.1006/urol.2000.0638-35.

Mahmood D, Dicianno B, Bellin M. Self-management, prevention and avoidable conditions and assessment of care among young adults with myelomeningocele. Child Care Health Dev. 2011 Nov; 37(6): 861–5. doi: 10.1111/j.1653-2334.2011.01299.x.

Lindehall B, Moller A, Hjalmars K, Jodal U, Abrahamsson K. Psychosocial factors in teenagers and young adults with myelomeningocele and clean intermittent catheterization. Scand J Urol Nephrol. 2008; 42(6): 359–44. doi: 10.1080/0036563090274639.

Husmann DA. Long-term complications following bladder augmentations in patients with spina bifida: bladder calculi, perforation of the augmented bladder and upper tract deterioration. Transl Androl Urol. 2016 Feb; 5(1): 3–11. doi: 10.3978/j.issn.2223-4683.2015.12.06.

Higashi TT, Granberg CF, Fox JA, Husmann DA. Augmentation cystoplasty and risk of neoplasia: fact, fiction and controversy. J Urol. 2010; 184(6): 2492–2. doi: 10.1016/j.juro.2010.08.038.

Mbeutcha A, Lucau I, Mathieu R, Lotan Y, Shariat SF. Current status of urinary biomarkers for detection and surveillance of bladder cancer. Urol Clin North Am. 2016 Feb; 43(1): 47–62. doi: 10.1016/j.ucl.2015.08.005.

Szymanski KM, Misseri R, Whittam B, Kaefer M, Rink RC, Cain MP. Quantity, not frequency, predicts bother with urinary incontinence and its impact on quality of life in adults with spina bifida. J Urol. 2016 Apr; 195(4 Pt 2): 1263–9. doi: 10.1016/j.juro.2015.07.108.

Ouyang L, Bolen J, Valdez R, Joseph D, Baum MA, Thibadeau J. Characteristics and survival of end stage renal disease patients with spina bifida in the United States renal data system. J Urol. 2015 Feb; 193(2): 558–64. doi: 10.1016/j.juro.2014.08.092.

DeLair SM, Eandi J, White MJ, Nguyen T, Stone AR, Kurzrock EA. Renal cortical deterioration in children with spinal dysraphism: analysis of risk factors. J Spinal Cord Med. 2007; 30(Suppl 1): S30–4. doi: 10.1080/10906288.2007.1175396.

Routh JC, Cheng EY, Austin JC, Baum MA, Gargollo PC, Grady RW, et al. Design and methodological considerations of the centers for disease control and prevention urologic and renal protocol for the newborn and young child with spina bifida. J Urol. 2016 Dec; 196(6): 1728–1734. doi: 10.1016/j.juro.2016.07.081.

Liptak GS, et al. Evidence-Based Practice in Spina Bifida: Developing a Research Agenda; 2003 May 9–10; Washington, DC. Arlington (USA): Spina Bifida Association of America; 2003.

Centers for Disease Control and Prevention. Urologic Management to Preserve Initial Renal Function Protocol for Young Children with Spina Bifida (UMPIRE). Available from: www.cdc.gov/ncbddd/spinabifida/umpire.html.
J. Sociodemographic attributes and spina bifida outcomes. Pediatrics. 2015 Apr; 135(4): e957–64. doi: 10.1542/peds.2014-2576.

[39] Szymanski KM, Cain MP, Whittam B, Kaefer M, Rink RC, Misseri R. All incontinence is not created equal: impact of urinary and fecal incontinence on quality of life in adults with spina bifida. J Urol. 2017 Mar; 197(3 Pt 2): 885–891. doi: 10.1016/j.juro.2016.08.117.

[40] Hopson B, Rocque BG, Joseph DB, Powell D, Jackson McLain AB, Davis RD, et al. The development of a lifetime care model in comprehensive spina bifida care. J Pediatr Rehabil Med. 2018; 11(4): 323–334. doi: 10.3233/PRM-180548.

[41] Hopson B, Alford EN, Zimmerman K, Blount JP, Rocque BG. Development of an evidence-based individualized transition plan for spina bifida. Neurosurg Focus. 2019 Oct 1; 47(4): E17. doi: 10.3171/2019.7.FOCUS19425.

[42] Centers for Disease Control and Prevention. About the National Spina Bifida Patient Registry. Available from: https://www.cdc.gov/ncbddd/spinabifida/nsbprregistry.html.
Enemeez® & Enemeez® Plus mini-enemas contain a delivered dose of 283 mg of docusate sodium

a solution proven effective for bowel care needs associated with spina bifida, spinal cord injury, traumatic brain injury, stroke, multiple sclerosis and general constipation in patients 12 years and older. A different formulation is available for children 2 to 12 years of age.

Bowel continence significantly affects quality of life for individuals with spina bifida. Enemeez (docusate sodium) provides a fast, effective and safe bowel management program, reducing time spent on bowel care.

Neurogenic Bowel, Constipation & Fecal Incontinence in Spina Bifida Patients

The hallmark clinical presentation is the inability to "voluntarily" control the defecation process or the inability to routinely perform elimination of stool/waste from the body. Patients with Spina Bifida may also experience:

- Constipation, very often severe
- Bowel obstructions, rectal impaction with sensory loss
- Hemorrhoids
- Nausea and vomiting
- Abdominal pain, bloating-distention, cramping, and lethargy - "sluggish feeling"
- Diet changes - decreased appetite - "grazing-snacking"
- Dehydration - electrolyte disturbances and increased UTI risk
- Soiling and unplanned evacuation of stool / social anxiety

Enemeez® & Enemeez® Plus Mini-Enemas are a Fast, Effective & Safe Solution

- Fast, predictable results typically in 2-15 minutes.¹
- Can assist in reducing time spent with patient for dressing/redressing due to episodes of incontinence or fecal discharge.²
- Can virtually eliminate episodes of incontinence.³
- No mucosal discharge ⁴; helps to maintain healthy skin integrity
- Non-irritating formula. No after-burn.
- Easy rectal usage for patients with reflux issues or nausea.
- Enemeez® Plus includes 20mg of benzocaine, assisting in the anesthetization of the rectum & lower bowel. The formulation was developed for patients who experience painful bowel movement.

Request Samples for Your Facility Today
alliancelabsprovider.com/enemeez

The material contained is for reference purposes only. Alliance Labs, LLC and Summit Pharmaceuticals do not assume responsibility for patient care. Consult a physician prior to use. Copyright 2020 Summit Pharmaceuticals and Alliance Labs LLC. Sources: 1. Federal Register / Vol. 50, No. 10 / Tuesday, January 15, 1985 / Proposed Rules; pgs. 2124-2558, 2. Rehabilitation Nursing (Dunn KL, & Galka ML 1999) Comparison of the Effectiveness of Therevac SB and Bisacodyl Suppositories in SCI Patients Bowel Programs, Rehabil Nurs. 19(6):334-8, 3. Alliance Labs in-house research Customer Survey April 27, 2011, 4. Made of Action, Alliance Labs in-house research customer survey Feb. 21, 2014.