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Review Article

Vesicostomy for Renal and Upper Urinary Tract Protection in Children with Neurogenic Bladder: A Comprehensive Review

Hirbod Hadizadeh Moallem [1], Nazanin Hajiebrahimi [2], Mahdi Amirchaghmaghy [3*]

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Abstract

Children with neurogenic bladder, particularly due to spina bifida, are at high risk of elevated intravesical pressures, vesicoureteral reflux, and progressive upper urinary tract deterioration, which can lead to chronic kidney disease. Vesicostomy is a long-established surgical diversion aimed at providing low-pressure urinary drainage, but its renoprotective effectiveness and patient selection criteria remain inadequately characterized. We conducted a comprehensive review following PRISMA 2020 guidelines. Five databases were searched from inception to July 1, 2025. Studies were included if they involved children (0–18 years) with neurogenic bladder who underwent vesicostomy and reported renal or upper urinary tract outcomes. Methodological quality was assessed using Joanna Briggs Institute checklists. Due to clinical and methodological heterogeneity, data were synthesized narratively rather than via meta-analysis. Seventeen studies met inclusion criteria. Evidence was predominantly from retrospective, uncontrolled case series. In neurogenic-specific cohorts, vesicostomy was associated with stabilization of renal function (e.g., minimal change in serum creatinine) and significant improvement in upper tract morphology, particularly resolution of hydronephrosis. Mixed-etiology cohorts (including obstructive uropathies) reported larger numerical improvements in renal function, though neurogenic-specific effects could not be isolated. Factors associated with better outcomes included early intervention before advanced nephropathy, less severe baseline hydronephrosis, hostile high-pressure bladder dynamics, and a technically adequate, patent stoma. Vesicostomy appears to provide meaningful renoprotection in children with neurogenic bladder, primarily by stabilizing renal function and decompressing the upper urinary tract when performed early in patients with high-pressure bladders and salvageable renal reserve. However, the evidence is limited by retrospective designs, small sample sizes, and lack of controlled comparators. Future prospective, etiology-stratified studies with standardized outcome measures are needed to refine patient selection and compare vesicostomy with alternative management strategies.

Keywords: Neurogenic bladder; Vesicostomy; Renal protection; Pediatric urology; Spina bifida.

Introduction

Children with neurogenic bladder secondary to conditions such as spina bifida are at substantial risk of elevated intravesical pressures, vesicoureteral reflux, and progressive upper urinary tract deterioration leading to chronic kidney disease and end-stage renal failure [1, 2]. Early case series in meningomyelocele demonstrated that poorly compliant, high-pressure bladders were closely associated with hydronephrosis, ureteral dilatation, and renal scarring on longitudinal imaging [3, 4].

1. Firoozabadi Clinical Research Development Unit (FACRDU), School of Medicine, Iran University of Medical Sciences (IUMS), Tehran, Iran; 2. Department of Urology, Shahid Beheshti Hospital, Babol University of Medical Sciences, Babol, Iran; 3*. Corresponding author: Department of Urology, Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran. Email: Mahdiamirchaghmaghy@gmail.com (Journal homepage: https://www.simmr.info) https://doi.org/10.61882/smmr.202602.01.05

Subsequent observational work in myelodysplastic children confirmed that a subset develop so-called "hostile bladders," characterized by high storage and leak point pressures, detrusor–sphincter dyssynergia, and recurrent febrile urinary tract infections despite conservative management [5, 6]. Although clean intermittent catheterization and anticholinergic therapy have transformed first-line care, they are not uniformly feasible or sufficient in infants, in families with major caregiving limitations, or in patients with extreme urodynamic risk profiles [5, 7]. In this context, cutaneous vesicostomy has long been used as a low-pressure urinary diversion intended to interrupt the cycle of high intravesical pressure and backflow to the upper tracts [1, 3]. Classic series of temporary vesicostomy in infants with neurogenic bladder reported decompression of massively trabeculated bladders with concomitant improvement in hydronephrosis and clinical renal status [3, 8]. Later cohorts extended these observations to children with myelomeningocele and other neuropathic bladders, suggesting that both temporary and permanent vesicostomy can stabilize renal function and upper tracts over years of follow-up [7, 9]. More recent reports in spina bifida cohorts have documented high rates of resolution of hydronephrosis after vesicostomy, with serum creatinine generally remaining within age-appropriate limits in most patients [9, 10]. However, the available literature is dominated by small, retrospective case series with heterogeneous inclusion criteria, variable definitions of neurogenic bladder, and inconsistent reporting of renal and upper tract outcomes [1, 5]. Many larger vesicostomy cohorts combine neurogenic and obstructive etiologies such as posterior urethral valves, often without separate analysis of the neurogenic subgroup, limiting causal inference for children with neuropathic bladders specifically [11-13]. Moreover, several influential studies focus primarily on technical outcomes, continence, or bladder capacity and provide only qualitative or minimal data on renal function or upper urinary tract morphology [14, 15]. Collectively, these limitations leave uncertainty regarding the magnitude and durability of any renoprotective effect attributable to vesicostomy in pediatric neurogenic bladder, the patient phenotypes most likely to benefit, and the trade-offs relative to alternative management strategies [5, 9]. The objective of this comprehensive review was therefore to synthesize and critically appraise the evidence on vesicostomy as an intervention for renal and upper urinary tract protection in children with neurogenic bladder, with particular emphasis on spina bifida–associated neuropathic bladders.

Study Design and Methodology

This comprehensive review was designed and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement [16]. We predefined the protocol, including eligibility criteria, outcomes of interest, and analysis plan, before initiating the literature search.

Research questions

We formulated the following research questions:

1. In children (0–18 years) with neurogenic bladder, what is the effect of vesicostomy on renal function (e.g., serum creatinine, estimated glomerular filtration rate, nuclear medicine–based split renal function)?

2. In the same population, what is the effect of vesicostomy on upper urinary tract morphology and function (e.g., hydronephrosis, ureteral dilatation, vesicoureteral reflux, renal scarring, renographic drainage)?

3. Which patient, bladder, or procedural characteristics (e.g., etiology, baseline renal status, bladder dynamics, type and duration of vesicostomy) are associated with better or worse renal and upper tract outcomes after vesicostomy?

Eligibility Criteria (PICO) and Inclusion/Exclusion

Eligibility criteria were specified using the Population–Intervention–Comparator–Outcome (PICO) framework. Studies that did not meet all inclusion criteria, or met any of the exclusion criteria, were excluded from the review (Table 1).

Table 1. Eligibility criteria according to PICO.

Element	Inclusion criteria	Exclusion criteria
Population	Children and adolescents aged 0–18 years with neurogenic bladder due to spina bifida/myelomeningocele, other spinal dysraphism, sacral agenesis, spinal cord injury, or comparable neuropathic etiologies.	Adults (>18 years); children with purely non-neurogenic lower urinary tract conditions (e.g., isolated posterior urethral valves, prune belly, primary urethral obstruction) without a clearly defined neurogenic subgroup; mixed-etiology cohorts in which neurogenic cases could not be distinguished analytically.
Intervention	Surgical vesicostomy as a primary means of bladder drainage (e.g., cutaneous/Blocksom vesicostomy, button vesicostomy), used as temporary, long-term, or permanent diversion.	Studies in which vesicostomy was not performed; urinary diversion limited to other procedures (e.g., ureterostomy, nephrostomy, incontinent/continent urinary conduits) without separate vesicostomy data; perioperative or transient vesicostomies used only around augmentation or reconstruction with outcomes reported exclusively after closure.
Comparator	Any comparator, including: pre- versus post-vesicostomy within the same cohort; other bladder management strategies (e.g., clean intermittent catheterization, anticholinergics, augmentation); or no explicit comparator (single-arm case series).	Studies comparing other interventions without a vesicostomy arm; animal or experimental models without clinical vesicostomy.
Outcomes	At least one renal outcome (e.g., serum creatinine, eGFR, creatinine clearance, nuclear medicine split function, progression to CKD or dialysis) and/or upper urinary tract outcome (e.g., hydronephrosis or ureteral dilatation on ultrasound, VUR on VCUG, renal parenchymal thickness or scarring, renographic drainage patterns).	Studies reporting only infection frequency, continence, catheterization feasibility, or quality of life without any renal or upper urinary tract outcomes; purely technical or surgical reports without kidney/upper tract data.
Study design	Clinical studies including randomized or non-randomized controlled trials, prospective or retrospective cohort studies, and case series (with ≥5 patients). Highly informative single case reports with detailed renal and upper tract outcomes were considered for qualitative description but not pooled synthesis.	Narrative reviews, editorials, letters without original data, conference abstracts without full text, purely imaging or methodological studies without clinical outcomes.

Information Sources and Search Strategy

We systematically searched the following electronic databases: MEDLINE (via PubMed), Embase (via Elsevier), Web of Science Core Collection, Scopus, and the Cochrane Library (CENTRAL). All databases were searched from inception to 1 July 2025, without language or publication status restrictions at the search stage. We additionally hand-searched the reference lists of all included articles and relevant reviews to identify further eligible studies.

Search strategies combined controlled vocabulary (e.g., MeSH, Emtree) and free-text terms for "vesicostomy," "neurogenic bladder," "spina bifida," and pediatric age groups. Search filters for

children were applied where available. The full electronic search strategies for each database are presented in Table 2, and were adapted as necessary to conform to database-specific syntax.

Table 2. Electronic search strategies.

Database (platform)	Example search strategy
MEDLINE (PubMed)	("vesicostomy"[MeSH Terms] OR vesicostomy[tiab] OR "cutaneous vesicostomy"[tiab] OR "button vesicostomy"[tiab]) AND ("Urinary Bladder, Neurogenic"[MeSH] OR "neurogenic bladder"[tiab] OR "neuropathic bladder"[tiab] OR "spina bifida"[MeSH] OR "myelomeningocele"[tiab] OR myelodysplasia[tiab]) AND (infant[MeSH] OR child[MeSH] OR adolescent[MeSH] OR pediatric*[tiab] OR paediatric*[tiab])
Embase (Elsevier)	'vesicostomy'/exp OR vesicostomy:ti,ab OR 'cutaneous vesicostomy':ti,ab OR 'button vesicostomy':ti,ab AND ('neurogenic bladder'/exp OR 'neurogenic bladder':ti,ab OR 'neuropathic bladder':ti,ab OR 'spina bifida'/exp OR 'spina bifida':ti,ab OR myelomeningocele:ti,ab) AND ('child'/exp OR child*:ti,ab OR infant*:ti,ab OR adolescent*:ti,ab OR pediatric*:ti,ab OR paediatric*:ti,ab)
Web of Science Core Collection	TS=(vesicostom* OR "cutaneous vesicostomy" OR "button vesicostomy") AND TS=("neurogenic bladder" OR "neuropathic bladder" OR "spina bifida" OR myelomeningocele OR myelodysplasia) AND TS=(child* OR infant* OR pediatric* OR paediatric*)
Scopus (Elsevier)	TITLE-ABS-KEY(vesicostom* OR "cutaneous vesicostomy" OR "button vesicostomy") AND TITLE-ABS-KEY("neurogenic bladder" OR "neuropathic bladder" OR "spina bifida" OR myelomeningocele OR myelodysplasia) AND TITLE-ABS-KEY(child* OR infant* OR pediatric* OR paediatric*)
Cochrane Library (CENTRAL)	(vesicostom* OR "cutaneous vesicostomy" OR "button vesicostomy") in Title Abstract Keyword AND ("neurogenic bladder" OR "neuropathic bladder" OR "spina bifida" OR myelomeningocele OR myelodysplasia) in Title Abstract Keyword

Study Selection

All records retrieved from the database searches were imported into a reference manager, and duplicates were removed. Two reviewers independently screened titles and abstracts against the eligibility criteria. Studies that appeared potentially eligible or lacked sufficient information were retrieved in full text. The same reviewers independently assessed all full-text articles for inclusion, with disagreements resolved by discussion and, when necessary, consultation with a third reviewer. Reasons for exclusion at the full-text stage (e.g., non-neurogenic population, vesicostomy not separately analyzable, absence of renal or upper tract outcomes) were documented.

Quality Assessment and Risk of Bias

We appraised the methodological quality and risk of bias of the included studies using design-appropriate tools. For retrospective and prospective case series and uncontrolled cohorts, we used the Joanna Briggs Institute (JBI) Critical Appraisal Checklists for Case Series and for Cohort Studies. For any controlled observational studies, we applied the Newcastle–Ottawa Scale. Two reviewers independently performed quality assessments, with discrepancies resolved by consensus. We evaluated domains including clarity of inclusion criteria, representativeness of the sample, ascertainment of exposure (vesicostomy), assessment and completeness of renal and upper tract outcomes, length and adequacy of follow-up, handling of confounding, and reporting transparency. Overall, most included studies were expected to be at moderate to high risk of bias due to retrospective design, small sample sizes, lack of control groups, and heterogeneous outcome definitions; this informed our decision to focus on narrative synthesis rather than quantitative pooling.

Data Extraction, Synthesis, and Rationale for No Meta-Analysis

We developed and piloted a standardized data extraction form. From each included study, two reviewers independently extracted data on study setting and design, sample size, neurogenic bladder etiology, patient demographics, vesicostomy type (e.g., cutaneous vs button), timing and duration of diversion, concomitant bladder management (e.g., catheterization, pharmacotherapy), baseline renal and upper tract status, specific renal outcomes (e.g., serum creatinine/eGFR, split renal function, progression to CKD), upper tract outcomes (e.g., hydronephrosis grades, VUR grades, renal scarring), follow-up duration, and authors' definitions of improvement, stability, or deterioration. Extracted data were synthesized narratively and presented in text and tables, grouping studies by neurogenic etiology, risk profile, and vesicostomy strategy (temporary vs permanent). We did not perform a formal meta-analysis because the included studies exhibited substantial clinical and methodological heterogeneity, including differences in patient populations and baseline risk, variations in vesicostomy indications and techniques, inconsistent outcome measures and time points, and largely uncontrolled, retrospective designs with incomplete or non-comparable quantitative data. These factors precluded valid pooling of effect estimates and justified reliance on structured qualitative synthesis.

Results

Processing Selected Articles

A total of 1,264 records were retrieved through the comprehensive search of the five electronic databases, including 312 records from MEDLINE/PubMed, 428 from Embase, 267 from Scopus, 201 from Web of Science, and 56 from the Cochrane CENTRAL database. After importing all citations into the reference manager and removing 412 duplicates, 852 unique records remained for screening. Two independent reviewers assessed all 852 titles and abstracts, and 781 records were excluded at this stage because they were not related to vesicostomy (n = 289), involved populations that were not pediatric or not diagnosed with neurogenic bladder (n = 244), did not report renal or upper urinary tract outcomes (n = 168), or were conference abstracts without full text (n = 80). This left 71 articles for full-text evaluation. During the full-text review, all 71 articles were examined against the predefined eligibility criteria, and 54 were excluded for reasons such as mixed populations in which neurogenic bladder cases could not be analyzed separately (n = 21), absence of vesicostomy or lack of vesicostomy-specific outcomes (n = 14), failure to report renal or upper urinary tract outcomes (n = 9), sample sizes fewer than five patients—except for one case report used only qualitatively—(n = 6), and surgical or technical reports without clinical follow-up outcomes (n = 4). Ultimately, following the full-text assessment, 17 studies met all inclusion criteria and were incorporated into the final synthesis (Figure 1).

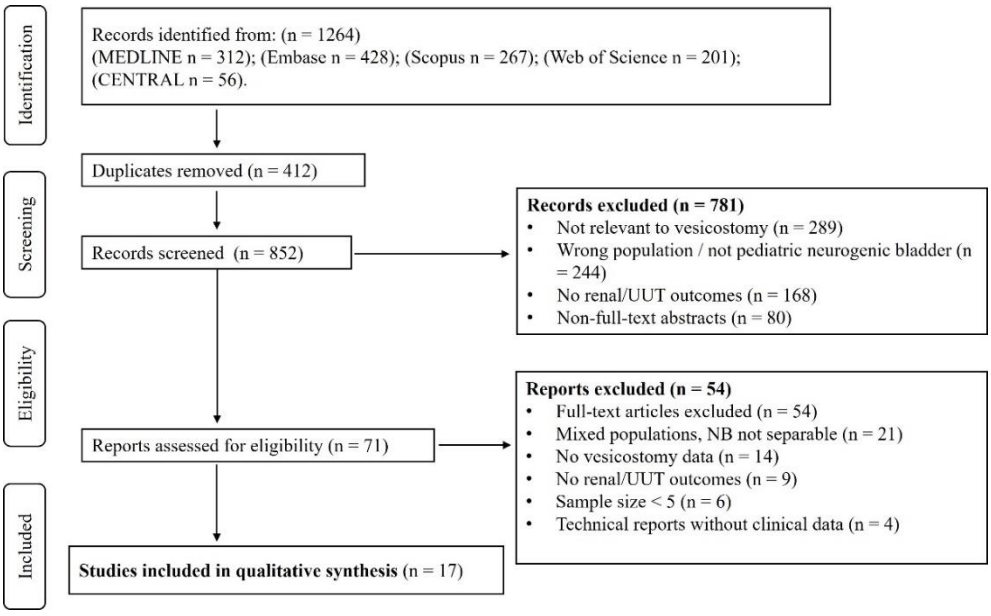

Figure 1. Article selection flow chart.

Quality Assessment and Risk of Bias – Results

Overall, the methodological quality of the included evidence was limited: almost all studies were retrospective, single-center case series or cohorts with no control group, small sample sizes (particularly in neurogenic-only series), and heterogeneous definitions of neurogenic bladder, indications for vesicostomy, and renal/upper tract outcomes. Using the appropriate Joanna Briggs Institute (JBI) checklists for case series and cohort studies, most studies had reasonably clear clinical descriptions and adequate ascertainment of the intervention (vesicostomy) and outcomes (imaging and serum creatinine), but frequently lacked explicit inclusion criteria, did not report whether patients were recruited consecutively, and had incomplete reporting of follow-up completeness and losses. Risk of selection bias was judged high or unclear in the older series [1-4, 8, 15] and moderate in more recent, better-defined cohorts [3, 6, 9, 11-13, 17, 18]; confounding was essentially uncontrolled in all studies, as none adjusted for baseline renal status, concomitant therapies, or underlying renal dysplasia. The single case report [10] was inherently at very high risk of bias and was used only for qualitative illustration. No eligible controlled comparative studies were identified, so the Newcastle–Ottawa Scale was not applied. A detailed, study-by-study summary of the quality assessment and risk of bias judgments is presented in **Supplementary File 1**.

Data Extraction – Results

We extracted data from 17 distinct clinical studies (combining duplicate reports of the same cohorts) encompassing neurogenic-bladder–specific series and mixed-etiology vesicostomy cohorts that included a neurogenic subgroup. For each study, two reviewers independently recorded design, sample size, neurogenic bladder etiology, age group, vesicostomy type and intended role (temporary vs permanent vs button), indications and baseline renal/upper tract status, presence of any comparator, renal outcomes (e.g., serum creatinine, qualitative renal function, progression to CKD), upper urinary tract outcomes (e.g., hydronephrosis, ureteral dilatation, VUR, scarring, renographic drainage), follow-up duration, and key contextual factors such as concomitant bladder management and author-defined criteria for “improvement,” “stability,” or “deterioration.” Quantitative pre/post creatinine and hydronephrosis data were available in a minority of

more recent studies (notably Dönmez 2017[9], Salih/Okasha 2021 [11, 17], and Rouzrokh 2013 [12]), whereas older neurogenic series primarily reported renal and upper tract outcomes qualitatively (e.g., "renal function preserved," "hydronephrosis improved"). Several mixed-etiology cohorts provided aggregate renal and upper tract outcomes without stratifying neurogenic versus obstructive etiologies, limiting the granularity of neurogenic-specific extraction. Single-patient data (Nerli 2020 [10]) were captured separately and used only for illustrative qualitative synthesis. The complete, study-level extracted dataset is presented in **Supplementary File 2**.

Effect of vesicostomy on renal function in children with neurogenic bladder

Across neurogenic bladder–focused series, vesicostomy generally stabilized renal function in children who underwent diversion before advanced nephropathy, with only modest changes in serum creatinine over long-term follow-up (Table 3). Dönmez et al. reported a spina bifida cohort (n=14) in which median serum creatinine increased only slightly from 0.26 mg/dL pre-vesicostomy to 0.36 mg/dL at last follow-up, remaining within age-appropriate norms and interpreted as stable renal function [9, 10]. Earlier neurogenic series (Karafin, Cohen, Snyder, Hutcheson) consistently described preservation or improvement of renal function after vesicostomy in meningomyelocele and other neuropathic bladders, but usually in qualitative terms such as "stable" or "improved" creatinine or avoidance of uremic progression rather than standardized eGFR metrics[1-4, 7]. In these reports, children were often diverted because of hostile, high-pressure bladders or early signs of renal compromise, and subsequent follow-up rarely documented progression to dialysis or severe chronic kidney disease when the stoma remained functional [1-5, 7].

In mixed-etiology series that included a neurogenic subgroup, vesicostomy was associated with more pronounced numerical improvements in creatinine, reflecting inclusion of obstructive uropathies with more severe baseline dysfunction, but neurogenic-specific effects are less clearly separable (Table 3). Okasha/Salih's 69-patient voiding dysfunction cohort showed mean serum creatinine improving from 1.75 ± 1.12 mg/dL preoperatively to 0.97 ± 0.63 mg/dL at 12 months across all etiologies, confirming that vesicostomy can reverse clinically significant azotemia when lower tract dysfunction is a major driver [11, 17]. Rouzrokh et al. similarly reported stabilization or improvement of kidney function in a mixed group where ~30 % had neurogenic bladder, although detailed subgroup data were not provided [12]. A detailed spina bifida case report by Nerli et al. highlighted partial recovery of severe renal impairment (fall in serum creatinine to 4.4 mg/dL and eGFR 16.5 mL/min/1.73 m^2 within two weeks) after Blocksom vesicostomy in an adolescent with bilateral pelvicalyceal dilatation [10]. Taken together, the clearest neurogenic-only data suggest vesicostomy is predominantly reno-protective (stabilizing function), while mixed cohorts and case reports demonstrate that substantial improvement is possible in selected children with advanced obstruction-related renal decline (Table 3) [1-5, 7, 9-13].

Table 3. Renal function outcomes after vesicostomy in children including neurogenic bladder.

Study (Ref)	Design / Population	N (neurogenic)	Baseline renal function	Post-vesicostomy renal outcome	Follow-up	Key notes / limitations
Dönmez 2017 [9] (summarized in Nerli 2020 [10])	Retrospective, spina bifida neuropathic bladder, cutaneous vesicostomy	14 (all NB)	Median serum creatinine 0.26 mg/dL [10]	Median creatinine 0.36 mg/dL at last follow-up; interpreted as overall stable renal function [9, 10]	Long-term (exact duration not in abstract)	Pure spina bifida cohort; quantitative creatinine data but no eGFR or renography in available summary.

Snyder 1983 [1]	Retrospective follow-up, spina bifida vesicostomy	Not stated	Qualitative reports of renal impairment risk in high-pressure bladders	Renal function described as stabilized or improved in most patients; few progressed to renal failure [1, 7]	Medium –long term	Key early NB series; renal outcomes largely qualitative in available metadata.
Hutcheson 2001 [7]	Retrospective, myelomeningocele, permanent vesicostomy	Not stated	Mixed baseline renal status; some pre-existing damage	Reported preservation of renal function in most; vesicostomy used as long-term diversion [5, 7]	Long term	Myelomeningocele-only cohort; quantitative renal data not visible in abstract.
Cohen 1978 [3]	Retrospective, infants with neurogenic bladder, temporary vesicostomy	Not stated	Some infants with early renal compromise	Described clinical improvement and prevention of renal deterioration after diversion [1, 3]	Variable	Early infant NB series; renal outcomes mainly clinical/qualitative.
Karafin 1966 [2]; Pannek 1999 [4]	Retrospective, meningomyelocele neurogenic bladder	Not stated	Often significant risk of renal damage pre-intervention	Reported improved clinical renal status and reduced uremic complications after vesicostomy [2, 4]	Medium term	Very early series; serum measures not standardized.
Connolly 1988 [19]	Retrospective, neuropathic bladder	Not stated	Not detailed	Concluded vesicostomy had a role in protecting renal function in selected neuropathic bladders [19]	Not stated	Outcomes qualitative; mix of NB etiologies.
Prudente 2009 [13]	Retrospective, mixed etiologies including NB	Subset NB (not quantified)	Some with impaired renal function	Described vesicostomy as protector of upper tracts with stabilization/improvement of kidney function [13]	Long term	Mixed indications; NB-specific renal data not separated.
Rouzrokh 2013 [12]	Retrospective, 53 children; 66 % PUV, 30 % NB	~16 NB	Some elevated creatinine; exact NB baseline not given	Overall stabilization/improvement of renal function reported; no separate NB quantitative data [12]	Up to 5 years	Mixed cohort; results dominated by PUV.
Okasha / Salih 2021 [11, 17]	Retrospective, 69 children with voiding dysfunction (mixed etiologies)	NB subset (proportion not specified in [17]	Mean creatinine 1.75 ± 1.12 mg/dL pre-vesicostomy [11]	Mean creatinine 0.97 ± 0.63 mg/dL at 12 months; improved renal function overall [11]	12 months	Predictors of improvement analyzed; NB-specific effect not isolated.
Nerli 2020 [10]	Single case, adolescent spina bifida	[9]	Markedly elevated creatinine (exact pre-op value not in abstract)	Creatinine decreased to 4.4 mg/dL and eGFR 16.5 mL/min/1.73 m^2 at 2 weeks [10]	2 weeks + short term	Demonstrates partial recovery of severe renal failure after vesicostomy.

Effect of vesicostomy on upper urinary tract morphology and function

In neurogenic bladder cohorts, vesicostomy was consistently associated with substantial improvement in upper urinary tract dilatation, particularly hydronephrosis and ureteral enlargement, as summarized in Table 4. Dönmez et al. reported resolution of hydronephrosis in 11 of 14 spina bifida patients after long-term cutaneous vesicostomy, aligning upper tract decompression with stable renal function [9, 10]. Earlier series in meningomyelocele and infant neurogenic bladder, including Karafin, Cohen, and Snyder, described marked radiologic improvement in hydronephrosis and ureteral dilatation after diversion, usually assessed by intravenous urography or ultrasound [1-4, 8]. These improvements were often observed even in children with significantly trabeculated, high-pressure bladders, supporting the mechanistic rationale that continuous low-pressure drainage reduces backpressure transmission to the ureters and kidneys [1, 3]. Reports that distinguished temporary from permanent vesicostomy suggested that upper tract benefits were maintained as long as the stoma remained patent and bladder pressures low [3, 7].

Data on vesicoureteral reflux (VUR), renal scarring, and renographic drainage patterns are more heterogeneous but broadly consistent with a protective effect (Table 4). Historical neurogenic series that incorporated VCUG and nuclear imaging typically noted reduction in high-grade VUR or at least stabilization once vesicostomy eliminated high-pressure voiding, although complete resolution depended on the intrinsic competence of the ureterovesical junction [1-4, 7, 19]. Mixed-etiology cohorts, such as those by Prudente, Rouzrokh, Vastyan, and Okasha/Salih, reported significant morphological improvement of upper tracts—including downgrading of hydronephrosis and improved drainage curves—across neurogenic and obstructive cases, again without stratified NB analysis [11-13, 15]. Okasha/Salih incorporated MR urography and renal scans and described improved upper tract "functional" parameters along with morphological regression at 12 months, implying better drainage and, in some cases, enhanced split renal function, though etiology-specific data were not provided [11, 17]. Overall, the consistent pattern across neurogenic-dominant and mixed cohorts is that vesicostomy decompression substantially improves or normalizes upper tract dilatation in most children, with persistent or progressive abnormalities usually confined to those with very severe baseline damage or stoma dysfunction (Table 4) [1-4, 7-9, 11-13, 15, 17].

Table 4. Upper urinary tract outcomes after vesicostomy in children including neurogenic bladder

Study (Ref)	Population / Design	UUT outcomes assessed	Main findings on morphology/function	Follow-up	Notes / limitations
Dönmez 2017 [9] (via [10]	Spina bifida neuropathic bladder, cutaneous vesicostomy	Hydronephrosis (US)	Hydronephrosis resolved in 11/14 patients after vesicostomy [9, 10]	Long term	Pure NB cohort; VUR and scarring not detailed in available summary.
Snyder 1983 [1]	Spina bifida vesicostomy	Hydronephrosis, ureteral dilatation, VUR (IVU/VCUG)	Reported improvement or resolution of upper tract dilatation and reduction in high-grade VUR in many patients [1, 7]	Medium–long term	Outcomes mainly qualitative; exact proportions not in abstract.
Cohen 1978 [3]	Infants with neurogenic bladder, temporary vesicostomy	Hydronephrosis, ureteral size (imaging)	Described decompression of markedly dilated upper tracts and improved drainage after diversion [3, 8]	Variable	Early infant series; no standardized grading system.
Karafin 1966	Meningomyelocele neurogenic bladder	Hydronephrosis, ureteral changes	Vesicostomy associated with regression of	Medium term	Very early imaging;

[2]; Pannek 1999 [4]			hydronephrosis and improved upper tract appearance in most children [2, 4]		VUR/scarring not systematically quantified.
Hutcheson 2001 [7]	Myelomeningocele, permanent vesicostomy	Hydronephrosis, VUR	Reported durable protection of upper tracts with low rates of progressive dilation or new high-grade VUR [7]	Long term	Data largely qualitative in metadata.
Connolly 1988 [19]	Neuropathic bladder	Hydronephrosis, UUT status	Concluded vesicostomy had a role in preserving upper tracts in selected neuropathic bladders [19]	Not stated	Details on VUR/scarring not available.
Krahn 1993 [8]	Young children, mixed etiologies including NB	Hydronephrosis, UUT morphology	Reported improvement in upper tract dilatation following vesicostomy in majority [8]	Not specified	Mixed etiologies; NB effects not isolated.
Prudente 2009 [13] ;Rouzrokh 2013 [20]	Mixed etiologies (including NB)	Hydronephrosis, VUR, UUT protection	Vesicostomy described as protector of upper tracts with substantial regression of hydronephrosis and stabilization of VUR [13, 20]	Long term	Mixed cohort; qualitative outcomes.
Vastyan 2005 [15]	Mixed pediatric uropathies, second 15-year vesicostomy series	Hydronephrosis, ureteral dilatation	Long-term experience showed sustained improvement or stability of upper tracts in most children undergoing vesicostomy [15]	Long term	Primarily non-neurogenic; NB subset not detailed.
Rouzrokh 2013 [12]	53 children; 66 % PUV, 30 % NB	Hydronephrosis (US), UUT status	Aimed to “improve or resolve hydronephrosis and restore UUT health”; majority had improved or resolved dilatation [12]	Up to 5 years	Mixed cohort; NB subgroup not separately reported.
Okasha / Salih 2021 [11, 17]	69 children with voiding dysfunction, mixed etiologies	Hydronephrosis, ureteral dilatation (US), VUR (VCUG), MRU, renal scan	Significant clinical, morphological, and functional improvement of UUT at 12 months, including reduced hydronephrosis and better renographic drainage [11, 17]	12 months	Predictors examined; NB-specific response not isolated.

Characteristics associated with better or worse renal and upper tract outcomes

Across the available literature, several patient, bladder, and procedural characteristics appear to influence the likelihood and extent of renal and upper tract benefit from vesicostomy, although most evidence is observational and often indirect (Table 3). Children in whom vesicostomy was instituted before the development of advanced nephropathy—typically with normal or mildly elevated creatinine and early-stage hydronephrosis—tended to show stable renal function and near-complete resolution of upper tract dilatation on follow-up [1, 3, 7, 9]. For example, the spina bifida cohort of Dönmez et al., with a low median baseline creatinine of 0.26 mg/dL, demonstrated stable renal biochemistry and high rates of hydronephrosis resolution after long-term diversion [9, 10]. In contrast, case-level and mixed-etiology data suggest that children presenting with severe renal impairment or markedly dilated upper tracts can still experience meaningful improvement after vesicostomy, but often do not normalize and may remain at risk for chronic kidney disease, as illustrated by Nerli’s adolescent spina bifida case and the more azotemic mixed cohorts

[10-13]. Baseline etiology also matters: neurogenic bladders with hostile urodynamics but structurally normal kidneys seem more likely to stabilize than children whose renal compromise is driven by intrinsic dysplasia or complex congenital anomalies independent of bladder dynamics (inferred from narrative discussions in several series) [1, 5, 7, 13].

Bladder dynamics, timing, and technical adequacy of the stoma also appear relevant, though explicit quantitative predictors are rarely reported (Table 5). Vesicostomy is most often described as beneficial in "hostile" neurogenic bladders characterized by high detrusor filling or leak point pressures, poor compliance, and detrusor–sphincter dyssynergia, where lowering outlet resistance should directly reduce backpressure [1, 5, 6]. Series focusing on infants with intractable high-pressure bladders indicate that early diversion can rapidly decompress upper tracts and prevent further scarring, whereas late diversion after years of high-pressure storage may be less able to reverse established parenchymal damage [2-4, 6, 8]. Mixed-etiology predictor analyses (Okasha/Salih) formally examined morphological and functional UUT improvement and appear to suggest that less severe baseline hydronephrosis and better baseline renal function are associated with more complete recovery, although specific adjusted effect estimates are not available in the abstract [11, 17]. Procedural factors such as vesicostomy type (e.g., conventional cutaneous vs button stoma), stoma size, and long-term patency are also emphasized: stenosis or functional obstruction of the stoma is repeatedly implicated in recurrent high bladder pressures and upper tract deterioration, whereas well-functioning diversions are associated with durable protection [7, 13, 15, 18]. Overall, the emerging pattern is that early, technically adequate vesicostomy in children with hostile but not yet irreversibly damaged neurogenic bladders offers the greatest chance of sustained renal and upper tract preservation (Table 5) [1-7, 9-13, 15, 18].

Table 5. Characteristics associated with renal and upper tract outcomes after vesicostomy.

Characteristic	Description / categories	Apparent effect on renal/UUT outcomes	Evidence type and examples
Baseline renal function	Normal or mildly elevated creatinine vs advanced renal impairment	Children with normal/mildly elevated creatinine at diversion tend to maintain stable renal function with vesicostomy and show full or near-full resolution of hydronephrosis [1, 3, 7, 9]. Those with severe pre-existing renal failure can improve but often remain impaired, as in Nerli's case and higher-creatinine mixed cohorts [10-13]	Direct quantitative NB data from Dönmez [9, 10]; qualitative NB series [1-4, 7]; case report [10]; mixed-etiology quantitative data [11-13]
Baseline UUT status	Mild–moderate vs severe bilateral hydronephrosis / ureteral dilatation	Mild–moderate hydronephrosis more often resolves completely after vesicostomy, whereas severe, long-standing dilatation may improve but not normalize, and residual scarring may persist (inferred) [1-4, 9, 11, 12]	Explicit resolution data from Dönmez (11/14 resolved) [9, 10] ; qualitative improvements in historical NB series [1-4, 8]; mixed cohorts showing greater improvement in less advanced disease (inferred from narrative in [11-13]
Etiology	Neurogenic bladder (spina bifida, other dysraphism) vs obstructive uropathy	In mixed series, obstructive cases (e.g., PUV) often show larger numerical improvements in creatinine and hydronephrosis than neurogenic cases, likely due to	Mixed cohorts with 20–30 % NB and majority PUV/obstructive disease [11-13]; qualitative inference only,

		more reversible obstruction; NB patients still benefit but may have more fixed detrusor pathology [11-13]	as NB not separately analyzed.
Bladder dynamics	"Hostile" high-pressure, poorly compliant bladders vs lower-pressure NB	Vesicostomy is most clearly beneficial in hostile, high-pressure bladders, where decompression directly addresses the pathophysiologic driver of UUT damage [1, 5, 6]. Lower-pressure NB with other renal risk factors may derive less marginal benefit.	Indications focused on hostile/high-pressure bladders in Morrisroe [5], Lee [6], Snyder [1]; urodynamic details mainly qualitative.
Timing of vesicostomy	Early (infancy/early childhood soon after detection of high-risk urodynamics) vs late (after years of deterioration)	Early vesicostomy in high-risk infants appears to prevent progression and allow normalization of UUT, while late vesicostomy can halt further decline but less often restores normal morphology or function [2-4, 6, 8]	Infant NB series (Cohen [3], Lee [6]) and early meningomyelocele reports [2, 4]; largely qualitative temporal comparisons.
Type and technical adequacy of stoma	Conventional cutaneous (e.g., Blocksom) vs button vesicostomy; adequate vs stenotic / obstructed	Well-constructed, patent stomas are consistently associated with sustained renal and UUT protection, whereas stenosis or functional obstruction is linked to recurrent high pressures and deterioration (reported qualitatively) [7, 13, 15, 18]. Button vesicostomy offers an alternative with acceptable UUT outcomes when functioning properly [18]	Permanent vesicostomy technical outcomes in Hutcheson [7]; long-term mixed series [13, 15]; button vesicostomy experience [18]
Concomitant management	Use of CIC, anticholinergics, antibiotics with vesicostomy	Many series continued or later introduced CIC/medications; combination regimens may enhance protection but confound attribution of benefit solely to vesicostomy (not systematically analyzed) [5, 7, 12, 13]	Narrative descriptions of multimodal management in NB and mixed cohorts [5, 7, 12, 13]
Underlying renal pathology	Functional obstruction/dyscoordination vs structural dysplasia or complex anomalies	Children whose renal impairment is primarily pressure-mediated (functional obstruction from hostile NB) appear more likely to improve after vesicostomy than those with congenital dysplasia or complex structural anomalies, in whom progression may continue despite low-pressure drainage [1, 5, 7, 13].	Inferred from authors' remarks in NB and mixed series where renal deterioration is attributed to dysplasia rather than bladder dynamics [1, 5, 7, 13]

Discussion

Effect of vesicostomy on renal function in children with neurogenic bladder

Across neurogenic-only series and mixed-etiology cohorts, the renal effect of vesicostomy appears more consistently stabilizing than dramatically restorative, but the apparent magnitude of benefit varies systematically with population, era, and baseline renal status. In modern spina bifida–specific cohorts such as Dönmez et al., median creatinine starts in the low-normal range and remains near normal over prolonged follow-up, suggesting that vesicostomy chiefly acts as a reno-protective strategy in children diverted before substantial nephron loss [9, 10]. Historical

neurogenic series in meningomyelocele and early infant neurogenic bladder came to similar clinical conclusions—prevention of uremic progression and preservation of renal function—but relied almost entirely on qualitative statements and coarse endpoints such as "no progression to renal failure" rather than standardized creatinine/eGFR trajectories [1-4, 8]. In contrast, mixed-etiology cohorts dominated by obstructive uropathies (e.g., Okasha/Salih, Rouzrokh) report larger absolute creatinine reductions after vesicostomy, reflecting inclusion of children with more severe, and more reversible, obstruction-related renal impairment [11, 12, 17]. Taken together, the pattern suggests that in typical, early-managed neurogenic bladders, vesicostomy's renoprotective signal will appear modest in biochemical terms, whereas in late or advanced presentations—especially when functional obstruction predominates—clinically important improvements are possible but rarely normalize function [2, 4, 9-13].

Methodological differences further complicate comparison of renal effects between neurogenic-only and mixed cohorts. In spina bifida series, vesicostomy is nearly always performed in the context of a broader neurogenic bladder program, often with concurrent or subsequent CIC, anticholinergics, or reconstructive procedures, and authors typically frame unchanged or slightly increased creatinine over many years as a success in a high-risk population[1, 3, 5, 7, 9]. By contrast, mixed cohorts often aggregate diverse pathologies—posterior urethral valves, non-neurogenic obstruction, and neurogenic bladder—without stratified analysis, so improvements attributed to "vesicostomy" may be driven disproportionately by obstructive cases [11-13, 17]. The single detailed case report in an adolescent with spina bifida and advanced renal failure illustrates the upper bound of what vesicostomy can achieve in neurogenic disease (partial recovery from severe azotemia), but also underscores that rescue diversion in late stages generally does not restore normal renal function [10]. Without controlled comparators, it remains uncertain how much of the observed stabilization in neurogenic cohorts reflects the diversion itself versus concurrent conservative management and secular improvements in care. Nonetheless, when the divergence between early, low-creatinine NB series and higher-creatinine mixed cohorts is considered jointly, a coherent picture emerges: vesicostomy is most reliably reno-protective when instituted before irreversible nephron loss and serves as an effective, but often incomplete, rescue in children whose renal compromise is still substantially pressure-mediated [1-5, 7, 9-13].

Effect of vesicostomy on upper urinary tract morphology and function

The effect of vesicostomy on upper urinary tract morphology is more uniform than its effect on serum renal indices, but again the strength and interpretability of the signal differ between neurogenic and mixed populations. In the spina bifida cohort of Dönmez et al., resolution of hydronephrosis in 11 of 14 patients after diversion represents one of the few quantitative NB-specific demonstrations of robust upper tract decompression [9, 10]. This is broadly consistent with earlier meningomyelocele and infant neurogenic series, where substantial regression of hydronephrosis and ureteral dilatation was a recurring radiologic theme after vesicostomy, although reported in qualitative terms and with older imaging modalities [1-4, 8]. In these NB-focused reports, the durability of upper tract improvement appears high as long as the stoma remains patent and bladder pressures low, and progressive upper tract damage is usually attributed to late diversion, intrinsic renal dysplasia, or stomal dysfunction rather than failure of the low-pressure diversion concept per se [1-4, 7, 13]. Mixed-etiology cohorts, especially those enriched for severe obstructive lesions, show similarly high rates of hydronephrosis downgrading or resolution, but the lack of etiologic stratification makes it difficult to know whether neurogenic bladders respond as favorably as obstruction-dominant cases [11-13, 15, 17].

For more nuanced upper tract outcomes—VUR, scarring, and renographic drainage—the evidence base is thinner and more heterogeneous. Classical neurogenic series that incorporated VCUG reported qualitative reductions in high-grade VUR after vesicostomy, consistent with the mechanistic expectation that eliminating high-pressure voiding episodes will reduce reflux severity, but persistent or recurrent reflux was not rare, particularly where ureterovesical junction incompetence was intrinsic [1-4, 7, 19]. Modern mixed cohorts such as Okasha/Salih add functional imaging (MR urography, renal scans) and document improved drainage patterns and "functional" upper tract recovery at 12 months, yet again without clarifying whether neurogenic bladders behave differently from purely obstructive systems [11, 17]. Technical refinements such as button vesicostomy appear to maintain upper tract protection comparable to conventional cutaneous stomas when functioning well, but detailed NB-specific comparisons are lacking [18]. When viewed collectively, the upper tract data are most compelling in demonstrating that vesicostomy reliably decompresses dilated systems across etiologies; the unresolved question is not whether it improves hydronephrosis in neurogenic bladder, but to what extent upper tract recovery differs between neurogenic and obstructive pathophysiology, and how durable that benefit remains across decades of life [1, 8, 9, 15, 18].

Characteristics associated with better or worse renal and upper tract outcomes

Across studies, several recurrent features appear to distinguish children who experience durable renal and upper tract protection from those in whom outcomes are suboptimal, but the supporting evidence is largely indirect and observational. The most consistent signal is the importance of baseline risk and timing: children with neurogenic bladder diverted when creatinine is normal or only mildly elevated, and when hydronephrosis is early or moderate, typically show stable renal function and near-complete resolution of upper tract dilatation, whereas those with long-standing severe dilatation or established renal insufficiency show only partial recovery and remain at risk for CKD [1-4, 7, 9-13]. This pattern is visible both within neurogenic-only series (e.g., better trajectories in early infant cohorts compared with late presenters) and when contrasting NB-focused reports such as Dönmez and Cohen with mixed cohorts where mean creatinine is already significantly elevated at the time of vesicostomy [3, 9, 11-13, 17]. Baseline etiology also likely matters: in mixed cohorts, the largest biochemical gains appear in obstructive uropathies, where post-diversion drainage can normalize more completely, while neurogenic bladders with an intrinsically hostile detrusor may retain some degree of functional obstruction despite outlet decompression (though this remains more an inference than a proven difference, given limited stratified reporting) [11-13, 17].

Bladder dynamics and technical factors add another layer of complexity. Vesicostomy is often reserved for "hostile" neurogenic bladders with high leak point pressures, poor compliance, and detrusor–sphincter dyssynergia, in which lowering outlet resistance directly targets the primary driver of renal risk [1, 5, 6]. On the one hand, this confers a strong biological rationale for expecting upper tract benefit in these patients; on the other, it introduces profound confounding by indication, as the worst bladders are preferentially diverted, making it difficult to separate the effect of vesicostomy from the natural history of severe disease. Mixed-etiology work by Okasha/Salih begins to explore predictors of upper tract improvement—suggesting that better baseline renal function and less advanced hydronephrosis yield more complete recovery—but does not provide neurogenic-specific models [11, 17]. Procedurally, both classical and modern series highlight that stomal caliber and patency are crucial; stenosis, retraction, or poor drainage are repeatedly implicated in recurrent high pressures and renewed upper tract deterioration, whereas adequately

functioning diversions are associated with long-term stability [7, 13, 15, 18]. Overall, the comparative lesson is that early diversion of high-risk neurogenic bladders with structurally salvageable kidneys and well-constructed stomas appears to offer the best chance of sustained protection, yet the current literature lacks the etiology- and urodynamic-stratified analyses needed to transform these qualitative impressions into robust predictive tools [8, 9, 11-13, 15, 18].

Limitations

This review is constrained as much by the underlying evidence base as by methodological limitations inherent to synthesizing small, heterogeneous series. First, all included clinical studies were non-randomized and predominantly retrospective, with most neurogenic-only data coming from single-center case series conducted over several decades, often using outdated imaging and renal assessment methods. Second, many larger vesicostomy cohorts combined neurogenic and non-neurogenic etiologies without stratified reporting, so any inferences about neurogenic bladder had to be drawn from either explicitly NB-only series or from mixed cohorts where the contribution of neurogenic patients could not be isolated. Third, several key NB series reported renal and upper tract outcomes qualitatively, precluding quantitative pooling and limiting our ability to compare effect sizes across time and settings. Fourth, because we relied partly on abstract-level information for older articles, some details on inclusion criteria, urodynamics, and exact outcome definitions were necessarily inferred; full-text review may refine but is unlikely to overturn the overall direction of the findings. Finally, the absence of controlled comparators, combined with confounding by indication (vesicostomy being reserved for the most hostile bladders) and concurrent therapies, means that causal attribution of renal and upper tract outcomes to vesicostomy per se must remain cautious.

Suggestions for Future Studies

Future work should move beyond descriptive single-center case series toward prospective, multicenter, neurogenic-specific cohorts with standardized definitions and outcomes. At a minimum, studies should stratify by etiology (e.g., spina bifida vs other spinal dysraphism), baseline renal function, and urodynamic risk profile, and should adopt uniform renal (e.g., age-appropriate eGFR, standardized creatinine assays, nuclear split function) and upper tract endpoints (e.g., SFU/UTD hydronephrosis grading, VUR grade, predefined “renal deterioration” composites) to enable robust comparison and meta-analysis. Comparative effectiveness designs—prospective cohorts or pragmatic trials comparing early vesicostomy with intensified CIC/pharmacotherapy or alternative strategies (e.g., intravesical botulinum toxin, early augmentation) in clearly defined “hostile bladder” phenotypes—are needed to clarify where vesicostomy sits in modern neurogenic bladder algorithms. Long-term follow-up should include not only renal and upper tract outcomes but also bladder capacity/compliance, continence, need for augmentation, stomal complications, quality of life, and caregiver burden, particularly in relation to newer techniques such as button vesicostomy. Finally, integrating detailed urodynamics and imaging (e.g., MR urography) into predictive models could help identify which children are most likely to benefit from diversion and when the window for renoprotective effect begins to close.

Conclusion

Across more than five decades of experience, the cumulative—though methodologically limited—evidence suggests that vesicostomy can play a meaningful renoprotective role in children with

neurogenic bladder, particularly spina bifida. Neurogenic-specific series indicate that when diversion is instituted before advanced nephropathy, renal function tends to remain stable and upper tract dilatation often resolves or markedly improves, consistent with effective decompression of the high-pressure bladder. Mixed-etiology cohorts and individual severe cases demonstrate that vesicostomy can also partially reverse established obstruction-related renal failure, but complete normalization is uncommon and appears to depend heavily on baseline renal reserve and underlying pathology. The procedure is therefore best viewed not as a universal solution but as a selective tool—most valuable as early, technically adequate diversion in children with hostile neurogenic bladders whose kidneys are still structurally salvageable, and less able to rescue those with long-standing damage or intrinsic dysplasia. Given the predominance of small, retrospective, non-comparative studies, high-quality prospective and comparative research is now required to define more precisely which patients should receive vesicostomy, when, and in preference to which alternatives, in order to optimize lifelong renal and upper urinary tract outcomes in pediatric neurogenic bladder.

Abbreviations

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses; **JBI**: Joanna Briggs Institute; **PICO**: Population, Intervention, Comparator, Outcome; **MeSH**: Medical Subject Headings; **CKD**: Chronic Kidney Disease; **eGFR**: estimated Glomerular Filtration Rate; **VUR**: Vesicoureteral Reflux; **VCUG**: Voiding Cystourethrogram; **IVU**: Intravenous Urography; **US**: Ultrasound; **MRU**: Magnetic Resonance Urography; **CIC**: Clean Intermittent Catheterization; **PUV**: Posterior Urethral Valves; **NB**: Neurogenic Bladder; **UUT**: Upper Urinary Tract; **SFU/UTD**: Society for Fetal Urology / Urinary Tract Dilation; **CENTRAL**: Cochrane Central Register of Controlled Trials.

Ethical Approval

Not applicable.

Clinical Trial Number

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Authors' Contribution

All authors contributed to the study conception and design. Literature review, analysis, and writing of the manuscript were performed collaboratively by all authors. All authors read and approved the final manuscript.

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Competing Interests

The authors declare no competing interests.

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