

Bibliometric profile of neurogenic bladder in the literature: a 20-year bibliometric analysis

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Abstract

Neurogenic bladder is a dysfunction of the lower urinary tract caused by nervous system disorder. We investigated the trends in publication of articles under the topic “neurogenic bladder” using bibliometric analysis. Articles on neurogenic bladder, published between 1995 and 2014, were retrieved from the ISI Web of Science citation database. We analyzed the search results for authors, countries, institutions, journals, and top-cited papers. A total of 1,904 articles were retrieved. There was a small increase in the number of articles on neurogenic bladder from 1995 ($n = 43$) to 2014 ($n = 117$). The USA was the leading country in the total number of articles ($n = 598$). However, the number of publications from China has rapidly increased, and China was ranked second in 2014. Emmanuel Chartier-Kastler ($n = 65$) was the most productive author, and University of Paris VI (Paris 6) ($n = 61$) was the most productive institution. *The Journal of Urology* published the greatest number of articles on this topic ($n = 285$). Articles on neurogenic bladder were often published in a professional journal under the category Urology & Nephrology, Neurosciences & Neurology, or Rehabilitation. Visualization analysis based on co-citation networks was conducted using CiteSpace III. Visualization analysis revealed that the hot spots in neurogenic bladder were botulinum toxin-A, prazosin, bethanechol, and afferent pathways. These findings provide new insight into the publication trends and hot spots in neurogenic bladder.

Key Words: nerve regeneration; neurogenic bladder; bibliometric analysis; Web of Science database; visualization analysis; CiteSpace III; citation analysis; neural regeneration

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Introduction

Neurogenic bladder is any dysfunctional condition of the lower urinary tract caused by injury or disease of the nervous system, including spinal cord injury, Parkinson's disease, and multiple sclerosis (Ginsberg, 2013). Neurogenic bladder is seen in 70–80% of spinal cord injury patients, 40–90% of multiple sclerosis patients, and 37–72% of Parkinson's patients (Ginsberg, 2013). The symptoms of neurogenic bladder include detrusor muscle overactivity, sustained high bladder pressure, urinary incontinence and sphincter-detrusor dyssynergia (Stohrer et al., 2009; Manack et al., 2011). Neurogenic bladder can lead to many complications, creating a substantial burden for patients. The proportion of patients with neurogenic bladder who have lower urinary tract infection, obstructive uropathy and urinary retention are 29–36%, 6–11% and 9–14%, respectively (Manack et al., 2011). It remains a challenge for clinicians to comprehensively diagnose and evaluate bladder function, and provide appropriate individualized care (Ginsberg, 2013).

Bibliometric analysis is a scientific method for investigating publications on a given topic, and has been changing the research landscape (Bornmann and Leydesdorff, 2014). Since Eugene Garfield established the Science Citation Index

(Garfield, 1964; Garfield, 1972), many bibliometric studies have analyzed scientific publications (Vioque et al., 2010; Jamshidi et al., 2013; Ahmad et al., 2014; Mao et al., 2014) in specific topics, including nerve research (Yang, 2012; Pan et al., 2013; Aleixandre-Benavent et al., 2014; Zhang et al., 2014).

Neurogenic bladder has been the subject of a variety of publications, including clinical guideline reports (Stohrer et al., 2009), clinical reviews (Klausner and Steers, 2011), and epidemiologic studies (Manack et al., 2011). However, the bibliometric profile of neurogenic bladder in the literature is still unknown. Therefore, in the present study, we conducted a bibliometric analysis on neurogenic bladder spanning a 20-year publication period (1995–2014). We analyzed the publications for author, year, country/region, journal, and most cited papers. In addition, we sought to identify the hot spots in neurogenic bladder.

Data and Methods

We used bibliometric analysis to study the profile of research articles on neurogenic bladder. We searched the Science Citation Index-Expanded (SCI-E) database through the Web of Science platform provided by Thomson Reuters. The SCI-E database is a widely accepted database comprising mostly

high-quality scientific publications. Furthermore, The SCI-E database is based on citation relation among literature. Therefore, we can perform citation analysis rigorously. The search strategy was “Neurogenic Bladder” or “Bladder Neurogenesis” or “Neurogenic Urinary Bladder” as the topic. We limited the publication period to 20 years, 1995–2014. The search was performed on January 8, 2015. Original articles were further analyzed. The records extracted were analyzed for citation characteristics, top-cited authors, countries, funding, institutions, and journals. We also analyzed the publishing trends of the top 10 countries in this period. The base analysis was performed using Histcite 12.03.07 (<http://www.histcite.com/>). We also used CiteSpace v. 3.6 (Chen and Chen, 2005; Synnestevedt et al., 2005; Chen, 2006; Chen et al., 2012) to visualize the trends and patterns in neurogenic bladder.

Results

General data

A total of 2,434 publications on neurogenic bladder, published from 1995 to 2014, were retrieved from the Web of Science. Of these publications, 1,904 (78.22%) were original articles (Table 1). The number of articles increased slightly during the 20-year period, although there was a peak in 2007 (Figure 1). The total citations peaked in 2004 (Figure 1).

Profile of articles

Of 1,904 original articles, 1,539 (80.83%) were cited no less than once. The remaining 365 articles (19.17%) were not cited. The total number of citations was 21,034, and the average citations per article was 11.05. The primary language of published articles on neurogenic bladder was English (1,661 articles) (Table 2).

Countries

The authors were from 64 different countries or regions. The leading country in the total number of articles on this topic was the USA, followed by France, Germany, and Japan (Table 3). The USA was also the leading country in the annual number of publications from 1995 to 2014, except 2007, in which France produced the most articles. China had a moderate growth in the number of annually published papers, and was second only to the USA in 2014 (Figure 2).

Authors

Emmanuel Chartier-Kastler, from France, was the first ranked author, with 65 articles (3.4%). Of the most prolific authors, five were from France, and two were from the USA (Table 4).

Institutions

The first-ranking institution was University of Paris 6, with 61 published articles (3.2%). Moreover, French institutions occupied six of the top ten positions in the number of published articles on neurogenic bladder between 1995 and 2014. However, the University of Pittsburgh in the USA had the highest number of citations per paper at 29.00 (Table 5).

Journals

The articles were published in 429 different journals. We identified the top 15 journals having published more than 20 articles related to neurogenic bladder between 1995 and 2014. The first ranked journal, publishing the most articles, was *The Journal of Urology* ($n = 285$), followed by two other journals with more than 100 articles each, *Neurourology and Urodynamics* ($n = 107$) and *Urology* ($n = 101$). *The Journal of Urology* also had the greatest number of total citations ($n = 5,575$) followed by *Urology* ($n = 1,831$) and *European Urology* ($n = 1,368$). However, the journal with the greatest number of average citations per paper was *European Urology* (25.3 citations per paper), followed by *The Journal of Urology* (19.6) and *Urology* (18.1). Among the top 15 journals, 12 were in the Web of Science category Urology & Nephrology. Among the top 15 journals, four were quartile 1 journals, four were quartile 2 journals, five were quartile 3 journals, and three were quartile 4 journals according to subject category in Journal Citation Reports (JCR) (Table 6).

Hot papers

We list articles with more than 100 citations in Table 7. The 10 most cited articles were published between 1995 and 2014. The top ranking paper, with 377 citations, published in *Journal of Neurotrauma*, was on recovery from spinal cord injury (Anderson, 2004). The second ranking paper was published in *Urology*, and received 296 citations (de Groat, 1997).

Visualization analysis

We conducted visualization analysis for co-cited burst terms in research articles retrieved from the Web of Science on neurogenic bladder, published between 1995 and 2014, using CiteSpace v. 3.6. The parameters in CiteSpace were as follows: timespan = 20 years (1995–2014); time slicing = 1; term type = burst terms; selection criteria (c, cc, ccv) = (4, 3, 20) (4, 4, 20) (4, 4, 20). The top 50 most cited or occurring items from each slice were selected. We used the Pathfinder network method to streamline the network, and mapped the visualization analysis. The network revealed 304 nodes and 612 lines. The articles with a centrality of more than 0.1 are presented in Table 8. The modularity Q was 0.7225, and the mean silhouette was 0.7516, with 22 co-citation clusters (Figure 3). We also present the time zone view for hot key words; the hot spots on neurogenic bladder were botulinum toxin-A, prazosin, bethanechol, afferent pathways, leukoencephalopathy, limb deficiency, motor neurons, transitional cell, nerve-terminals, pelvic floor dysfunction, and fecal incontinence (Figure 4).

Discussion

To the best of our knowledge, this is the first bibliometric analysis on the topic of neurogenic bladder. Our results show a mild increase in the number of publications worldwide on the topic of neurogenic bladder (Figure 1). The USA had the greatest number of published articles on neurogenic bladder. However, a growing research contribution of China has

Table 4 Top 10 authors publishing articles on neurogenic bladder between 1995 and 2014

Rank	Author	Institution	Country	No. of articles	Proportion (%)	Total citations	Citations per paper
1	Chartier-Kastler E	Univ Paris 6	France	65	3.4	459	7.06
2	Ruffion A	Hop Henry Gabrielle	France	54	2.8	139	2.57
3	Denys P	Hop Ray Poincare	France	39	2.0	293	7.51
4	Pannek J	Ruhr Univ Bochum	Germany	34	1.8	455	13.38
5	Schurch B	Univ Hosp Balgrist	Switzerland	29	1.5	575	19.83
6	Chancellor MB	Univ Pittsburgh	USA	24	1.3	552	23.00
7	Game X	CHU Toulouse	France	22	1.2	127	5.77
8	De Seze M	CHU Bordeaux	France	20	1.1	195	9.75
9	De Groat WC	Univ Pittsburgh	USA	19	1.0	809	42.58
10	Yamanishi T	Chiba Univ	Japan	19	1.0	459	24.16

Table 1 Number of articles and proportion of each publication type on neurogenic bladder between 1995 and 2014

Article type	No. of articles	Proportion (%)
Article	1,904	78.23
Review	217	8.92
Proceedings paper	209	8.59
Meeting abstract	164	6.74
Editorial material	95	3.90
Letter	21	0.86
Note	11	0.45
Reprint	3	0.12
Discussion	3	0.12
Correction	2	0.08
News item	1	0.04
Book chapter	1	0.04

Table 2 Top 10 languages in published original articles on neurogenic bladder between 1995 and 2014

Rank	Language	No. of articles	Proportion (%)
1	English	1,661	87.2
2	French	121	6.4
3	German	79	4.1
4	Spanish	20	1.1
5	Turkish	10	0.5
6	Portuguese	4	0.2
7	Czech	3	0.2
8	Italian	2	0.1
9	Japanese	2	0.1
10	Polish	2	0.1

emerged. China ranked second only to the USA in 2014. This phenomenon was observed in other bibliometric analyses as well (Zhang et al., 2012; Mao et al., 2014; Yao et al., 2014). This analysis indicates that China is a major competitor for North America and Western Europe in publishing scientific research (Migaud, 2012). Previous studies have also shown that the scientific contribution of Mainland China has increased notably (Cheng and Zhang, 2010; Xu et al., 2011; Zhang et al., 2012; Ye et al., 2014). This phenomenon may be associated with government-initiated incentives (Franzoni et al., 2011). However, in terms of citations per paper, China ranked 10th among the top 10 countries publishing the most

Table 3 Top 10 countries publishing articles on neurogenic bladder between 1995 and 2014

Rank	Country	No. of articles	Proportion (%)	Total citations	Citations per paper
1	USA	598	31.4	9,060	15.15
2	France	185	9.7	1,593	8.61
3	Germany	163	8.6	1,752	10.75
4	Japan	159	8.4	1,483	9.33
5	Canada	89	4.7	1,204	13.53
6	UK	79	4.1	1,009	12.77
7	Turkey	77	4	443	5.75
8	Switzerland	63	3.3	686	10.89
9	Peoples R China	59	3.1	249	4.22
10	Netherlands	57	3	935	16.40

articles between 1995 and 2014. A reason for the low number of citations per paper from China may be that many of the papers were published later than those from other countries. However, the quality of research appears to be the major factor determining the number of citations.

The language of the publication may affect the number of citations. Articles in English have more opportunity to be acquired, read and cited, because most international journals are published in English and can be searched in open databases such as PubMed and Google scholar. Indeed, most papers from China were in English or Chinese, and this may have affected the number of citations received.

Among institutions, University of Paris 6 published more than two-thirds of the articles from France, and was the first-ranked institution, publishing the most articles on neurogenic bladder between 1995 and 2004. Furthermore, the first ranked author, Emmanuel Chartier-Kastler, was based at University of Paris 6. The third most cited article, "European experience of 200 cases treated with botulinum-A toxin injections into the detrusor muscle for urinary incontinence due to neurogenic detrusor overactivity" (Reitz et al., 2004), was also from the Chartier-Kastler laboratory. Thus, Chartier-Kastler and University Paris 6 were the leading author and institution, respectively, on this topic. The top 15 journals publishing articles on neurogenic bladder were all professional journals. Articles were in areas such as Urology & Nephrology, Neurosciences & Neurology, Rehabilitation,

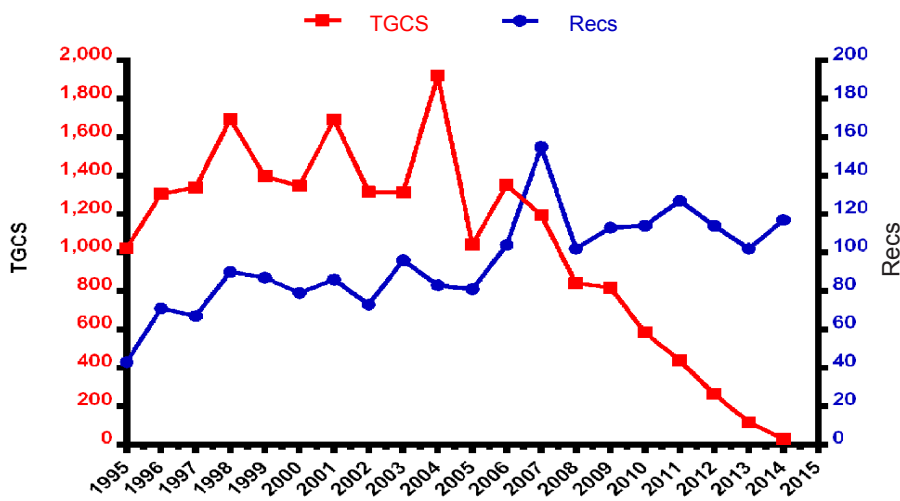


Figure 1 Number of published articles and citations on neurogenic bladder during 1995 to 2014. Total Global Citation Score (TGCS) shows the total number of citations for a paper in the Web of Science. Number of Records (Recs) shows the number of records for a given item.

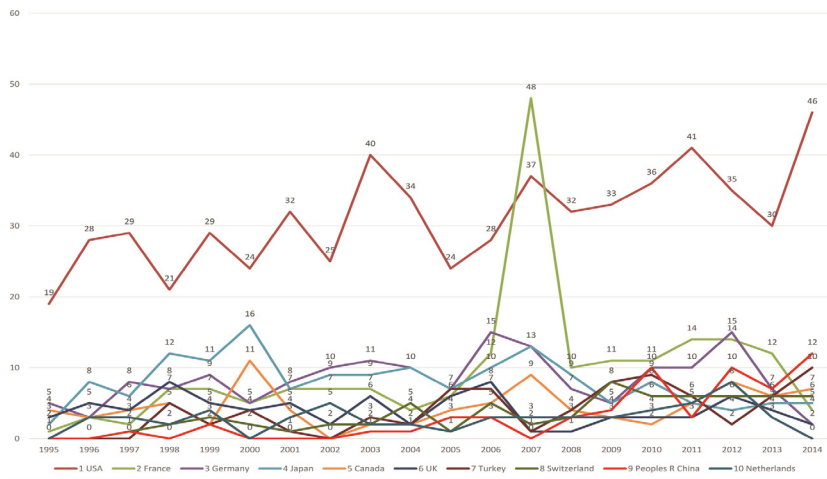


Figure 2 Trends in the publication of articles on neurogenic bladder by the top 10 productive countries from 1995 to 2014.

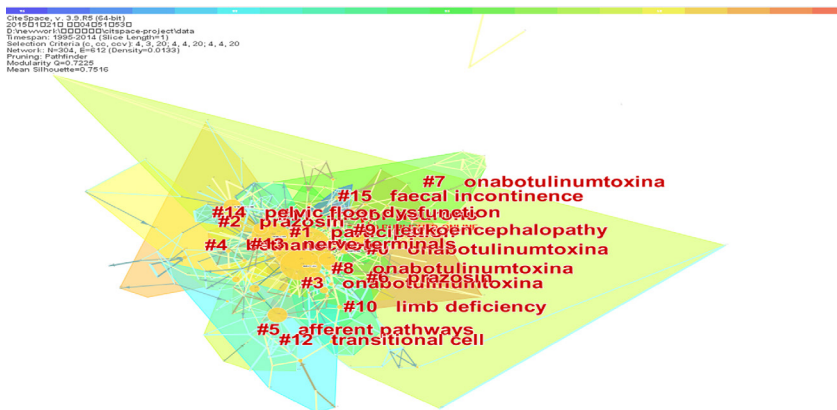


Figure 3 Visualization analysis for co-citation burst terms in research articles on neurogenic bladder between 1995 and 2014 retrieved from the Web of Science (analyzed using CiteSpace v. 3.6). The figure shows the clustering and burst terms.

Pediatrics, and Surgery.

The top 10 cited articles were also analyzed to reveal the areas of great interest in neurogenic bladder. The most cited articles were focused on spinal cord injury (Westgren and Levi, 1998; Anderson, 2004), botulinum toxin (Reitz et al., 2004), etiology of neurogenic bladder (de Groat, 1997), carcinoma of the rectum (Havenga et al., 1996), streptococcal disease (Jackson et al., 1995), bladder outlet obstruction

(Nitti et al., 1999), diabetic neuropathy (Dubey et al., 2004), cerebral palsy (Murphy et al., 1995), and urge urinary incontinence (Davila et al., 2001). These highly cited papers help identify the major points of interest in research on neurogenic bladder.

We conducted visualization analysis using CiteSpace, based on co-citation theory (Li et al., 2014). The modularity Q (0.7225) and the mean silhouette (0.7516) revealed that

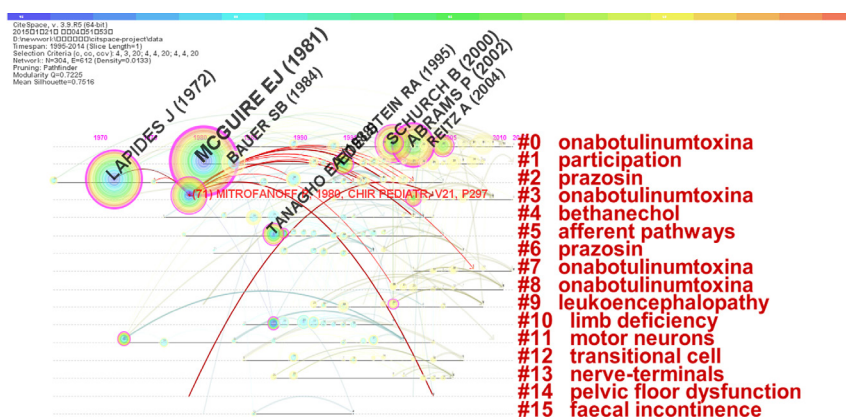


Figure 4 High-frequency key words in the timeline plot for publications on neurogenic bladder between 1995 and 2014 retrieved from the Web of Science (analyzed using CiteSpace v. 3.6).

The horizontal line shows the clusters. The circles represent the amount of literature. The curved line represents the relationships between the clusters.

Table 5 Top 10 institutions publishing articles on neurogenic bladder between 1995 and 2014

Rank	Institution	Country	No. of articles	Proportion (%)	Total citations	Citations per paper
1	Univ Paris 6	France	61	3.2	512	8.39
2	Univ Pittsburgh	USA	42	2.2	1,218	29.00
3	Childrens Hosp	USA	33	1.7	601	18.21
4	UCBL Lyon 1	France	26	1.4	41	1.58
5	Harvard Univ	USA	23	1.2	319	13.87
6	Baylor Coll Med	USA	20	1.1	424	21.20
7	Univ Toronto	Canada	20	1.1	271	13.55
8	Chiba Univ	Japan	19	1.0	234	12.32
9	Northwestern Univ	USA	19	1.0	130	6.84
10	Univ Calif San Francisco	USA	16	0.8	358	22.38

Table 6 Top 15 journals publishing articles on neurogenic bladder between 1995 and 2014

Rank	Journal	No. of articles	Total citations	Citations per paper	Impact factor 2013	Web of Science categories	Quartile
1	<i>The Journal of Urology</i>	285	5,575	19.6	3.753	Urology & Nephrology	Q1
2	<i>Neurourology and Urodynamics</i>	107	1,251	11.7	2.458	Urology & Nephrology	Q2
3	<i>Urology</i>	101	1,831	18.1	2.132	Urology & Nephrology	Q2
4	<i>Progrès En Urologie</i>	81	169	2.1	0.77	Urology & Nephrology	Q4
5	<i>BJU International</i>	80	908	11.4	3.13	Urology & Nephrology	Q1
6	<i>Spinal Cord</i>	70	702	10.0	1.699	Neurosciences & Neurology; Rehabilitation	Q3; Q2
7	<i>European Urology</i>	54	1,368	25.3	12.48	Urology & Nephrology	Q1
8	<i>Journal of Spinal Cord Medicine</i>	42	280	6.7	1.978	Neurosciences & Neurology	Q3
9	<i>Journal of Pediatric Urology</i>	28	43	1.5	1.413	Pediatrics; Urology & Nephrology	Q3
10	<i>Urologe</i>	28	32	1.1	0.436	Urology & Nephrology	Q4
11	<i>Urologia Internationalis</i>	27	144	5.3	1.151	Urology & Nephrology	Q3
12	<i>Aktuelle Urologie</i>	26	74	2.8	0.28	Urology & Nephrology	Q4
13	<i>International Journal of Urology</i>	25	126	5.0	1.91	Urology & Nephrology	Q2
14	<i>Journal of Pediatric Surgery</i>	23	218	9.5	1.311	Pediatrics; Surgery	Q3
15	<i>Pediatric Nephrology</i>	22	282	12.8	2.881	Pediatrics; Urology & Nephrology	Q1

the clustering result was acceptable. Using this visualization analysis, we were able to identify co-citation hot spots.

There are limitations to our study. We only searched the Web of Science; other literature databases were not searched. Therefore, we might not have been able to retrieve all papers on this topic, and selection bias may have been present.

Conclusion

The major findings of the present bibliometric study are as

follows. (1) There has been a mild increase in the number of articles on neurogenic bladder over the last 20 years. (2) The USA was the leading country in the total number of articles; however, the number of papers from China has rapidly increased. (3) Emmanuel Chartier-Kastler and University of Paris 6 were the most productive author and institution, respectively, and articles on neurogenic bladder were often published in a professional journal in the subject category Urology & Nephrology, Neurosciences & Neurology or

Table 7 Ten most-cited articles on neurogenic bladder between 1995 and 2014

Rank	First author	Article	Journal	Year of Publication	Number of citations
1	Anderson KD	Targeting recovery: Priorities of the spinal cord injured population	<i>J Neurotrauma</i>	2004	337
2	De Groat WC	A neurologic basis for the overactive bladder	<i>Urology</i>	1997	296
3	Reitz A	European experience of 200 cases treated with botulinum-A toxin injections into the detrusor muscle for urinary incontinence due to neurogenic detrusor overactivity	<i>Eur Urol</i>	2004	215
4	Havenga K	Male and female sexual and urinary function after total mesorectal excision with autonomic nerve preservation for carcinoma of the rectum	<i>J Am Coll Surg</i>	1996	213
5	Westgren N	Quality of life and traumatic spinal cord injury	<i>Arch Phys Med Rehabil</i>	1998	213
6	Jackson LA	Risk factors for group B streptococcal disease in adults	<i>Ann Intern Med</i>	1995	140
7	Nitti VW	Diagnosing bladder outlet obstruction in women	<i>J Urol</i>	1999	134
8	Duby JJ	Diabetic neuropathy: An intensive review	<i>Am J Health Syst Pharm</i>	2004	131
9	Murphy KP	Medical and functional status of adults with cerebral palsy	<i>Dev Med Child Neurol</i>	1995	122
10	Davila GW	A short-term multicenter, randomized double-blind dose titration study of the efficacy and anticholinergic side effects of transdermal compared to immediate release oral oxybutynin treatment of patients with urge urinary incontinence	<i>J Urol</i>	2001	103

Table 8 Highly-cited (“classical”) publications (co-cited with most centrality) retrieved by CiteSpace visualization analysis

Centrality	Frequency	Year of Publication	First author	Title	Journal
0.55	122	1981	Mcguire EJ	Prognostic value of urodynamic testing in myelodysplastic patients	<i>J Urol</i>
0.39	74	2002	Abrams P	The standardisation of terminology of lower urinary tract function: Report from the of the International Standardisation Sub-Committee Continence Society	<i>Neurourol Urodyn</i>
0.35	102	1972	Lapides J	Clean, intermittent self-catheterization in the treatment of urinary tract disease	<i>J Urol</i>
0.19	49	1988	Tanagho EA	Electrical stimulation in the clinical management of the neurogenic bladder	<i>J Urol</i>
0.17	25	2000	Weld KJ	Differences in bladder compliance with time and associations of bladder management with compliance in spinal cord injured patients	<i>J Urol</i>
0.16	71	1980	Mitrofanoff P	Trans-appendicular continent cystostomy in the management of the neurogenic bladder	<i>Chir Pediatr</i>
0.16	33	2002	Schafer W	Good urodynamic practices: uroflowmetry, filling cystometry, and pressure-flow studies	<i>Neurourol Urodyn</i>
0.16	29	1988	Geraniotis E	The prophylactic use of clean intermittent catheterization in the treatment of infants and young children with myelomeningocele and neurogenic bladder dysfunction	<i>J Urol</i>
0.14	41	2005	Schurch B	Botulinum toxin type a is a safe and effective treatment for neurogenic urinary incontinence: results of a single treatment, randomized, placebo controlled 6-month study	<i>J Urol</i>
0.14	30	1973	Hinman F	Vesical and ureteral damage from voiding dysfunction in boys without neurologic or obstructive disease	<i>J Urol</i>
0.11	46	1995	Edelstein RA	The long-term urological response of neonates with myelodysplasia treated proactively with intermittent catheterization and anticholinergic therapy	<i>J Urol</i>
0.1	70	2000	Schurch B	Botulinum-A toxin for treating detrusor hyperreflexia in spinal cord injured patients: a new alternative to anticholinergic drugs? Preliminary results	<i>J Urol</i>
0.1	41	2000	Weld KJ	Effect of bladder management on urological complications in spinal cord injured patients	<i>J Urol</i>
0.1	24	1989	Cartwright PC	Bladder autoaugmentation: early clinical experience	<i>J Urol</i>

Rehabilitation. (4) The hot spots on neurogenic bladder were botulinum toxin-A, prazosin, bethanechol and afferent pathways. These results provide novel insight into the publication trends and hot spots on neurogenic bladder. Our findings may be useful for administrators managing neurogenic bladder research, as well as for researchers in planning and coordinating their own studies.

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