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Flow characteristics of urethral catheters of the same caliber vary between manufacturers

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Summary

Background
Clean intermittent catheterization (CIC) is frequently prescribed for bladder dysfunction, either per urethra or via a continent catheterizable channel. Small catheters may be required for infants or continent channels. Success with CIC is highly dependent upon patient and family compliance. The urinary flow rate through the catheter is an important factor, which can decrease CIC time and improve quality of life. There is little objective information regarding flow rate through urinary catheters to guide catheter recommendation or prescription. Clinically, we noted that there was a difference in flow among catheter brands, and we questioned if catheters of the same-labeled diameter exhibit the same flow characteristics, which could have implications for catheter selection.

Methods
Twenty-one commercially available male pediatric urinary catheters from nine brands were tested (11 straight tip, 10 coude tip). Nine of the 21 tested catheters had a hydrophilic coating. All tested catheters shared a 10F outer diameter. For each, microscopic imaging and a precision caliper were used to measure the inner diameter and tip inlet area. A hydraulic system modified from ASTM standard testing specifications was used to simulate bladder catheterization. Measurement of each catheter was repeated five times using three different static hydraulic pressures (20, 40 and 50 cmH_2O). Catheter flow rate and structural measurements were identified and the fastest and slowest of the catheters are presented in the table. The variable flow rates between brands were due to the differences in catheter structural characteristics such as the inner diameter (ID) and the tip inlet area to inner lumen area ratio (AR). The maximum variation of flow rate of all tested 10F catheters was 48%, ID varied up to 22%, from 1.71 to 2.11 mm or 5.13–6.33F. AR varied up to 166%. The table delineates the fastest and slowest rates at three measured pressures. The outer diameter labeled 10F on packaging was true to size.

Conclusions
Based on packaging information, providers, and patients are unable to predict urinary flow through a catheter and thus use information regarding flow rate to guide catheter selection. This information cannot be calculated based on ideal flow calculations and could be listed on packaging to assist physicians and families in selecting the optimal urinary catheter for CIC.

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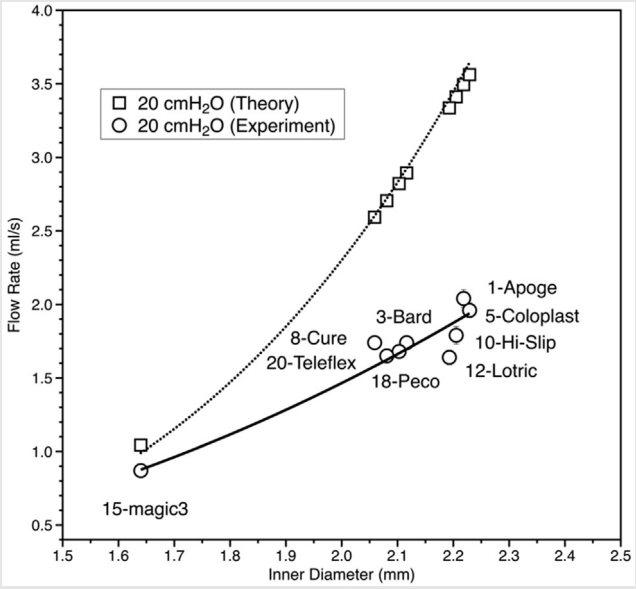
Table Catheters listed by name, tip shape, coating characteristic, and ID.

No.	Product Name		Tip	Gel	I.D. (mm)	A.R.	Flow Rate (ml/min.) 20 cmH_2O	40 cmH_2O	50 cmH_2O
1	Apogee	IC	S		2.05	1.65	122.4	192.6	230.8
2			C		2.09	1.99	124.2	204.0	235.6
3	Bard	Clean-Cath	S		2.04	1.78	104.4	168.0	202.0
4			C		2.06	2.42	106.8	181.2	211.3
5	Coloplast	SelfCath	S		2.07	1.62	117.6	198.0	218.0
6		SpeediCath	S	Y	2.09	1.23	126.6	168.6	229.8
7			C	Y	2.09	1.49	114.6	159.6	220.3
8	Cure	Catheter	S		1.97	1.50	104.4	166.2	198.5
9			C		2.05	1.44	114.0	190.2	218.1
10	Hi-slip	Plus	S	Y	2.09	1.07	107.4	162.0	196.9
11			C	Y	2.11	1.10	124.2	189.0	224.9
12	LoFric	Primo	S		2.11	2.01	98.4	175.2	201.4
13			C		2.04	2.26	111.6	186.0	204.4
14		Origo	C	Y	1.99	2.37	107.4	187.8	218.2
15	Magic3	Hydrophilic	S		1.71	4.04	52.2	88.8	110.3
16			S	Y	1.72	4.02	60.0	103.2	129.0
17			C	Y	1.75	3.66	58.8	106.2	129.8
18	Peco	IC	S		2.07	1.65	100.8	166.2	195.4
19			C		2.07	1.68	112.2	176.4	213.8
20	Teleflex	Flocath	S	Y	1.96	1.75	99.0	162.0	191.3
21			C	Y	1.83	1.88	81.6	130.2	157.2

ID = inner diameter; S = straight; C = coude; Y = coated; blank = uncoated. fx1
The pink represents the highest values at the 3 different pressures. The red represents the lowest.



Summary Figure This chart demonstrates the flow rates of the catheters at three different pressures. The graph displays the actual flow rates compared to the ideal flow rates.

Introduction

Clean intermittent catheterization (CIC) is a valuable tool employed in the management of bladder dysfunction of various etiologies in children. The goals for urinary management for children using CIC are to promote continence and prevent renal deterioration [1,2]. Before introduction of CIC in the 1970s, there was significant morbidity associated with neurogenic bladder from urosepsis and renal failure [3]. McGuire et al. [4], in the 1980s, determined detrusor leak point pressures greater than 40 cmH_2O led to upper tract deterioration, and this number is often used to guide urologic treatment. Patient and family cooperation with a CIC regimen may directly affect upper and lower urinary tract function [5] and may help prevent urinary tract infection (UTI) [6–8].

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