Pilot Evaluation of Functional Questionnaire for Predicting Ability of Patients With Tetraplegia to Self-Catheterize After Continent Diversion

Ardavan Akhavan, MD¹; Karin Baker, MD²; Glenn M. Cannon, MD¹; Benjamin Davies, MD¹; John A. Horton III, MD²; Steven G. Docimo, MD¹

¹Department of Urology, Children's Hospital of Pittsburgh, Pittsburgh, Pennsylvania; ²Department of Pain Management and Rehabilitation, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania

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Abstract

Background/Objectives: Creation of a continent catheterizable stoma has dramatically improved the ability of the patient with spinal cord injury to perform clean intermittent catheterization (CIC). However, not all patients are good candidates for this procedure. To aid in patient evaluation, we propose the use of a functional questionnaire to predict a candidate's ability to negotiate a continent catheterizable stoma.

Methods: A published functional questionnaire was adapted to assess the self-perceived ability to perform upper extremity tasks similar to those involved in the manipulation of catheter. Tetraplegic patients who had undergone creation of a content catheterizable stoma were given the questionnaire and asked to describe demographics, method of catheterization, motivational factors, and satisfaction with the procedure.

Results: Subjects varied in age (23–36 years) and level of impairment (C4–C6). Functional scores correlated with level of injury. Of the 4 women and 1 man who responded, only 2 were able to self-catheterize before diversion. Their catheterization times decreased significantly after creation of a continent stoma. Two patients unable to perform CIC preoperatively were able to perform CIC postoperatively. The patient with the lowest score was unable to perform CIC preoperatively or postoperatively. All were satisfied with outcome after diversion.

Conclusions: In our small cohort, a low functional score was associated with inability to perform CIC after continent diversion. Administration of this questionnaire to a larger spinal cord injury population should aid in selecting appropriate candidates for the creation of a continent catheterizable stoma.

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INTRODUCTION

In the treatment of patients with spinal cord injuries, proper management of the neurogenic bladder is imperative. Patients with spinal lesions above the sacral micturition center typically present with detrusor hyperreflexia and dyscoordination of the external urethral sphincter with or without reflex micturition. The resulting elevated intravesical pressure predisposes the upper urinary tract to hydronephrosis and renal failure. Until recent decades, chronic renal failure was the most

common cause of mortality in these patients (1). However, there have since been several advances in the management of the neurogenic bladder.

Common treatment options include indwelling catheters with either a suprapubic or urethral tube, external sphincterotomy with condom catheter, urinary diversion, or clean intermittent catheterization (CIC). Although these methods have been effective in preserving renal function, they are not without shortcomings (2). Indwelling catheters are associated with urinary tract infections (UTIs), calculi, malignancy, and urethral injuries; in addition, they must be changed and maintained. External sphincterotomies have a 30% failure rate in reducing intravesical pressures to levels adequate for prevention of upper tract disease (3) and are also associated with a high

Please address correspondence to Steven Docimo, MD, Pediatric Urology, Children's Hospital of Pittsburgh, 3705 Terrace Street, Pittsburgh, PA 15213; phone: 412.692.7932; fax: 412.692.7939 (e-mail: steven.docimo@CHP.edu).

rate of erectile and ejaculatory dysfunction (2). Urinary diversion through an ileal conduit can lead to ileo-ureteral reflux, late ureteroileal obstruction, and subsequent renal failure after many years (4).

CIC allows for low-pressure, volume-adapted bladder emptying with decreased instrumentation, providing lower risk of trauma, infection, and upper urinary tract damage. However, tetraplegic patients with impaired upper extremity function are limited in their ability to self-catheterize. Female patients have an especially difficult time negotiating CIC. The location of the female urethral meatus often necessitates that patients transfer to a supine position and undress. The feasibility of this tedious routine is often compounded by lower limb spasticity and flexion contractures. As such, women with tetraplegia using CIC often require the assistance of a caretaker, thereby compromising privacy, independence, social functioning, and quality of life. Pinchplasty and other reconstructive hand surgeries have been shown to improve the ability of tetraplegic patients to use CIC in 51% to 86% of cases, depending on the degree of underlying impairment (5). Unfortunately, the need to undress and lie in a supine position is often still a great inconvenience, if not an insurmountable barrier.

An option for these patients is the surgical construction of a continent catheterizable stoma through the abdominal wall. Several studies have reported generally successful outcomes of this surgery in aiding CIC and restoring independence (2,6–9). The caveat to the continent stoma is that candidates must be carefully selected to have the physical abilities to fully benefit from such a procedure. Unfortunately, there are no guidelines for screening such patients, and the ideal candidate has yet to be defined. We propose use of a functional questionnaire to aid in the workup for a continent catheterizable stoma, with the hypothesis that it is predictive of the ability to self-catheterize after diversion. We adapted a previously developed upper extremity questionnaire to assess the self-perceived ability to perform manual tasks similar to those involved in the negotiation of an abdominal stoma (10). For this study, we gave the functional questionnaire to patients who had already undergone continent urinary diversion and retrospectively assessed how the surgery has impacted their lives. We review the responses from our cohort.

METHODS

Patient Population

Institutional Review Board approval was obtained to identify and survey patients with continent catheterizable stomas being treated at our institution (IRB 0506032). Inclusion criteria consisted of all patients with spinal cord injuries who were status-postcontinent stoma diversion. There were no exclusion criteria. Six potential subjects were identified, and 5 were available for participation. The last patient could not be reached.

Questionnaire

A previously published upper-extremity functional questionnaire (10) was modified with 5 new, previously untested items designed to assess the subject's self-perceived ability to perform upper extremity tasks similar to those involved in the manipulation of a catheter, such as pinching a pen or turning over a coin (Appendix 1). All participating subjects were asked to score themselves on a scale from 1 (lowest) to 7 (highest), with potential scores ranging from 42 to 294. A score of 294 would represent a normal, healthy adult, whereas a score of 168 would represent a significantly impaired individual who scores an average of 4 of 7 on the functional indices. Subjects were asked to describe how the diversion has affected their lives with regards to ability to catheterize, number of UTIs, incontinence, and overall satisfaction with the procedure. Patient demographics, including age, level of injury, type of reconstruction, and social factors were also determined.

RESULTS

Patient Population

Patient statistics are listed in Table 1. Of the 5 patients who participated, 4 were women and 1 was a man. Patients had continent diversion a median of 5 years (range, 3–8 years) before participation in our study. Median age at time of injury was 19 years (range, 17–22 years); median age at time of surgery was 23 years (range, 19–23 years); and median age at time of questionnaire was 27 years (range, 23–36 years). One patient had a C4 level lesion; 3 were injured at C5, and 1 at C6. The patients were diverted with a bladder tube ($n = 2$), sigmoid tube ($n = 1$), and appendix ($n = 2$). Three patients' bladders were augmented with ileum at the time of diversion. Three subjects also had prior upper limb reconstructive surgeries, including 1 patient with both bilateral biceps to triceps graft and a Freehand functional electrical stimulation system implant (Neuro-Control Corporation, Cleveland, OH), another with unilateral tendon transfer, and 1 with a brachial radialis transfer. Before diversion, all were managed with anticholinergic medications and urethral CIC.

Functional Score

In our cohort, the median functional score was 191 (range, 102–212). The level of injury was related to functional score. The patient with a C6 level injury scored a 212; the 3 with C5 injuries scored themselves at 205, 195, and 122, respectively. The subject with C4 injury had the greatest level of impairment with a score of only 102.

Social Factors

At the time of surgery, all patients were either in college or had graduated. Since the time of surgery, 3 of the 5 have completed or are currently obtaining postgraduate degrees. All 5 spend the majority of their time outside of

Table 1. Patient Statistics

Patient ID	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5
Age (years)	36	23	28	26	27
Sex	Woman	Woman	Woman	Woman	Man
Years since injury	14	4	9	9	8
Years since surgery	5	3	4	8	6
Level of injury	C5	C6	C5	C4	C5
Self-CIC ability presurgery	No	Yes	No	No	Yes
Time to CIC presurgery (minutes)	20	40	10	20	20
Self-CIC ability postsurgery	Yes	Yes	Yes	No	Yes
Time to CIC postsurgery (minutes)	5	4	2	2	5
Bladder augment?	Yes	Yes	No	Yes	No
Upper extremity surgeries?	No	Yes	No	Yes	Yes
No. weekly incontinence episodes presurgery	25	2	8	7	1–2
No. weekly incontinence episodes postsurgery	2	0	0	5	0
No. annual UTIs presurgery	0	10	15	8	4
No. annual UTIs postsurgery	0	1	1	1	0
Raw functional score	205	212	191	102	122

the home working as either full-time employees or students. Two of the 5 are in committed relationships and live with their significant others; all 5 have substantial local social support and family networks.

Impact of Continent Diversion

Before the continent diversion, the female subject who scored a 212 and the male patient who scored a 122 were the only individuals who could catheterize themselves. The female subject was able to do this in the seated and supine positions; however, she had to undress from the waist down. After the creation of a continent catheterizable stoma, she was able to decrease the time to self-catheterize from 40 to 4 minutes by grasping the catheter between her palms and negotiating her abdominal stoma. The male subject could catheterize himself approximately 50% of the time before his diversion, and the process took an average of 20 minutes. After the creation of a stoma, the subject was able to consistently catheterize himself within 5 minutes with the assistance of a catheter clamp device.

The two female subjects who scored 205 and 191, respectively, were unable to catheterize before their operations. After diversion, they could both self-catheterize in less than 5 minutes. One pinches the catheter between her thumbs, and the other uses two index fingers and one thumb to manipulate the device. In contrast, the female patient who scored a 102 could not manipulate her catheter before or after the creation of a continent catheterizable stoma. Thus, the functional score was loosely associated with the ability to self-catheterize not only before, but also after, diversion.

All 5 patients experienced a decrease in the number of weekly incontinence episodes. Before surgery, the patients reported a median of 7 weekly (range, 2–25/wk) episodes of incontinence. After stoma creation, the median number of episodes was reduced to 0 (range, 0–5). In addition, 4 of the 5 patients had problems with frequent UTIs. After surgery, however, all reported a median of 0 (range, 0–1) infections annually. Bladder augmentation did not seem to be associated with incontinence or UTI outcomes.

DISCUSSION

CIC is the most effective way to manage the urinary tracts of patients with spinal cord injuries. However, the need to access the urethra poses a problem for many patients with impaired upper extremity function and is especially problematic for women. The surgical construction of a continent catheterizable stoma can be an effective option for this group of patients. The ideal patient would have enough upper extremity function to be able to manipulate a catheter through an abdominal stoma; however, there are no predictive indices to aid in the workup of patients for this procedure. The proposed functional questionnaire is designed to predict the success with which a patient will be able to self-catheterize after continent diversion. Although many functional tests exist for the evaluation of upper extremity dexterity and strength, our proposed questionnaire is the first designed specifically to assess the ability to self-catheterize. Additionally, because our assessment is a questionnaire and not a physical examination, patients are spared potentially cumbersome and exhaustive physical assessments of strength and dexterity.

In our cohort, functional scores correlated with the patients' ability perform CIC before and after the diversion. Among the 4 women in our study, only the patient who scored 212, the highest in our cohort, could self-catheterize before diversion. After the procedure, all except the subject with the lowest score, 102, could perform CIC independently. Self-catheterization of the female urethra is generally more difficult than manipulation of the male urethra. As such, the functional score of the men and women should be considered separately, because men with limited upper limb abilities may be able to self-catheterize, whereas women with the same degree of impairment may not. Appropriately, in our study, the male patient had a functional score of only 122 but was still able to catheterize himself before surgery; this contrasts with the 2 female patients who scored 191 and 205, respectively, and were unable to self-catheterize preoperatively.

The predictive value of the proposed functional questionnaire may be decreased by patient-specific motivational factors. The subjects in our study were all young, highly motivated, and ambitious, with extensive support networks to aid in rehabilitation. Given a favorable functional score, a candidate in a less ideal social situation may not fare as well as predicted by the questionnaire. As such, we recommend the proposed questionnaire be used only as a part of a more extensive workup including physical, social support, and motivational assessments of each candidate.

Interestingly, the ability to self-catheterize was not the only benefit of surgery. Although only 4 of the 5 patients were able to self-catheterize after the procedure, all 5 were overwhelmingly satisfied with their outcomes. All of the female patients we surveyed, regardless of functional score or ability to self-catheterize, no longer had to undress or transfer to a supine position for CIC. In addition, patients benefited from fewer UTIs and episodes of incontinence after the diversion. The one patient who was unable to self-catheterize after surgery still considered the procedure "life changing." It should be noted this subject had a full-time professional caretaker to assist in CIC. If access to such support is not an issue, perhaps the ability to self-catheterize should not be considered as highly when deciding on urinary management. Given the responses from our cohort, we propose that such a procedure could potentially benefit a significant proportion of patients with tetraplegia who would still be unable to perform CIC, even after diversion.

The results of our study support the proposed functional questionnaire as a quick and accurate method of assessing a patient's ability to self-catheterize after a continent diversion. However, our relatively small sample

size precludes any general guidelines. This pilot study serves to influence future larger studies that will further assess the validity of the questionnaire. Once sex-specific cut-off values are determined, the functional score will be a valuable predictive tool in the evaluation of patients with tetraplegia for creation of a continent catheterizable stoma.

CONCLUSIONS

The proposed functional questionnaire is designed to predict a patient's ability to use a continent catheterizable stoma. In our study, the functional scores correlated with level of spinal cord injury and ability to self-catheterize both before and after continent diversion. Given its predictive value, the functional questionnaire may be a useful tool in the evaluation of a candidate for a continent diversion. However, the ability to self-catheterize should not be the only consideration when evaluating a patient for this procedure.

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Appendix 1

FUNCTIONAL QUESTIONNAIRE

This questionnaire is designed to find out how well you are able to use your arms and hands. I will ask you about a number of actions which some people with spinal cord injury have limitations performing. Please consider whether, on an average day, you have difficulties these actions. By this I mean difficulty doing the action, or trouble doing it as often as you would like or need in order to complete everyday activities. Consider only the specific part of your arm or hand asked about in each question. For example, if asked about pulling something with your arm, do not worry about whether or not you can grab it with your hand.

Pick one of the following responses to indicate how much, if any, limitation you have:

7. Not at all limited
6. A little limited
5. Some limitation
4. Moderately limited
3. Very limited
2. Extremely limited
1. Totally limited, can't do it at all

The following questions are about your ability to reach or lift:

1. Think about reaching out with your arm to touch something directly in front of you that is at shoulder level:
 - a) How limited are you doing this using your RIGHT ARM?
 - b) How limited are you doing this using your LEFT ARM?
2. Think about raising your arm directly over your head, with your arm straight:
 - a) How limited are you doing this using your RIGHT ARM?
 - b) How limited are you doing this using your LEFT ARM?
3. Think about reaching down to touch the floor and sitting back up straight, without hooking your other arm or using it to pull yourself up:
 - a) How limited are you doing this with your RIGHT HAND?
 - b) How limited are you doing this with your LEFT HAND?
4. Think about raising a 5-pound object like a heavy blanket over your head using both arms. (Don't worry about whether you could grab it with your hands, just if you could raise something that heavy over your head.):
 - a) How limited are you doing this with BOTH ARMS?

The following questions are about your ability to pull and push with both of your arms:

5. Think about pulling or sliding (without grasping) a light object such as a can of soda, that is on a table, towards you:
 - a) How limited are you doing this kind of thing using your RIGHT ARM?
 - b) How limited are you doing this kind of thing using your LEFT ARM?
6. Think about pulling or sliding (without grasping) a heavy object (up to 10 lbs.), that is on a table, towards you:
 - a) How limited are you doing this kind of thing using your RIGHT ARM?
 - b) How limited are you doing this kind of thing using your LEFT ARM?
7. Think about pushing a light object such as a can of soda on a table, away from you:
 - a) How limited are you doing this kind of thing using your RIGHT ARM?
 - b) How limited are you doing this kind of thing using your LEFT ARM?
8. Think about pushing a heavy object (up to 10 lbs.) on a table, away from you:
 - a) How limited are you doing this kind of thing using your RIGHT ARM?
 - b) How limited are you doing this kind of thing using your LEFT ARM?
9. Think about pushing down with both arms into your chair enough to lift your buttocks (both sides) off the seat (do a push-up weight shift):

How limited are you doing this?

The following questions are about moving and positioning your arm and wrist:

10. With your hand on your lap palm down, think about curling your wrist upwards, keeping your arm on your lap:
 - a) How limited are you doing this motion using your RIGHT HAND?
 - b) How limited are you doing this motion using your LEFT HAND?
11. Think about turning your hand over—from your palm facing up to facing the floor, keeping your elbow bent at your side (the arm motion someone would make when turning a doorknob or a dial):
 - a) How limited are you doing this motion using your RIGHT ARM?
 - b) How limited are you doing this motion using your LEFT ARM?

The following questions are about using your hands and fingers:

12. Think about grasping and holding an object like a hammer with your hand:
 - a) How limited are you doing this kind of thing using your RIGHT HAND?
 - b) How limited are you doing this kind of thing using your LEFT HAND?

13. Think about picking up a small object such as a paper clip or the cap of a tube of toothpaste with the tips of your thumb and first two fingers:
 - a) How limited are you doing this kind of thing using your RIGHT HAND?
 - b) How limited are you doing this kind of thing using your LEFT HAND?
14. Think about pinching and holding an object between your thumb and the side of your index finger, such as holding a key:
 - a) How limited are you doing this kind of thing using your RIGHT HAND?
 - b) How limited are you doing this kind of thing using your LEFT HAND?
15. Think about grasping a large object like the lid of a jar of baby food with the tips of the fingers hard enough to pick the jar up or open the lid:
 - a) How limited are you doing this kind of thing using your RIGHT HAND?
 - b) How limited are you doing this kind of thing using your LEFT HAND?
16. Think about using your fingers to manipulate objects, such as holding a coin and turning it over and over with your fingers:
 - a) How limited are you doing this kind of thing using your RIGHT HAND?
 - b) How limited are you doing this kind of thing using your LEFT HAND?
17. Think about pressing something with the tip of your index finger (not knuckle) such as dialing a touch-tone phone or ringing a doorbell:
 - a) How limited are you doing this kind of thing using your RIGHT HAND?
 - b) How limited are you doing this kind of thing using your LEFT HAND?
18. Think about reaching out with your arm to touch something directly to your side that is at shoulder level:
 - a) How limited are you doing this with your RIGHT HAND?
 - b) How limited are you doing this with your LEFT HAND?
19. Think about holding an object using your fingers and the surface of your palm (such as holding a tennis ball):
 - a) How limited are you doing this kind of thing using your RIGHT HAND?
 - b) How limited are you doing this kind of thing using your LEFT HAND?
20. Think about holding an object using your thumb and first two fingers (it may, but need not have, contact with the web of the thumb), such as holding a pen or pencil:
 - a) How limited are you doing this kind of thing using your RIGHT HAND?
 - b) How limited are you doing this kind of thing using your LEFT HAND?
21. Think about holding an object using your thumb in opposition to your fingers to hold an object such as a soda can (the object may have contact with the palm):
 - a) How limited are you doing this kind of thing using your RIGHT HAND?
 - b) How limited are you doing this kind of thing using your LEFT HAND?
22. Think about holding an object between your fully straightened fingers and thumb (no object contact with the palm) as with picking up an envelope?
 - a) How limited are you doing this kind of thing using your RIGHT HAND?
 - b) How limited are you doing this kind of thing using your LEFT HAND?