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Yu-Lin Tsai

Mao-Hsiung Huang

Chia-Hsin Chen

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Case Report

Novel Orthoses for Male Hemiplegic Patients to Perform Clean Intermittent Catheterization: A Case Report

Yu-Lin Tsai,¹ Mao-Hsiung Huang,^{1,2} Chia-Hsin Chen^{1,2}

¹Department of Physical Medicine and Rehabilitation, Kaohsiung Medical University Hospital, Kaohsiung;

²College of Medicine, Kaohsiung Medical University, Kaohsiung.

A 37-year-old male suffered from hemorrhagic stroke with left side hemiplegia and neurogenic bladder. On admission, due to post-renal acute renal failure with hydronephrosis, he received indwelling catheterization but felt very uncomfortable. However, he was physically unable to perform clean intermittent catheterization (CIC) due to his hemiplegia. Two novel devices were designed to help him perform CIC using one side of his body. As in our experience with this case, hemiplegic patients may now be able to perform CIC by themselves to achieve adequate bladder drainage using one-sided limbs under the assistance of the novel orthoses. (Tw J Phys Med Rehabil 2010; 38(3): 175 - 180)

Key Words: neurogenic bladder, intermittent catheterization, orthosis, stroke

INTRODUCTION

Neurogenic bladder (NB) represents a malfunctioning urinary bladder due to neurologic dysfunction caused by any trauma, diseases, or injury.^[1] Variable symptoms and complications of NB include urinary incontinence, urinary retention, urinary tract infection, urinary stone, and urinary reflux with possible subsequent kidney damage. There are many strategies for managing bladder dysfunction including behavioral strategies, urine collection devices, clean intermittent catheterization (CIC), pharmacological treatment, injection therapy, sacral nerve neuromodulation, surgical treatment, etc.^[2-9] Different management strategies are chosen according to different types of bladder dysfunction.

CIC is an effective way to manage patients with detrusor hyperreflexia and incontinence.^[2,10] It can effec-

tively reduce complications such as hydronephrosis, vesico-ureteral reflux, kidney stone, and bladder stone caused by abnormal urine retention. Low morbidity and high patient acceptance are the most advantageous characteristics of CIC.^[11] From the viewpoint of rehabilitation, it also makes patients feel more comfortable to do training exercises, to regain function, and to regain psycho-social health.^[12] It has been reported that CIC is a successful long-term option to drain bladders in spinal cord injury patients who can perform catheterization independently.^[13]

There are some prerequisites for people to perform CIC: functional hands, good trunk balance, and good cognitive functioning. These conditions require that patients are capable of accessing the inguinal area, reaching the urethral opening, and operating the necessary equipment and materials. Partial assistance provided by a caregiver may also be needed if the patient is in a severely dependent state.

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Correspondence to: Dr. Chia-Hsin Chen, Department of Physical Medicine and Rehabilitation, Kaohsiung Medical University Hospital, No. 100, Tzyou 1st Road, Kaohsiung 807, Taiwan.

Tel : (07) 3121101 ext 5962 E-mail : chchen@kmu.edu.tw

However, victims of cerebral vascular accident usually have sequelae such as hemiplegia, poor balance control, and prolonged dependent status, thus, it would be more difficult for these stroke patients to perform CIC by themselves. Being incapable of performing CIC and feeling uncomfortable with indwelling catheterization would reduce patients' quality of life and motivation for doing rehabilitation exercises.^[14] Therefore, devices designed to assist hemiplegic patients to perform CIC could allow patients to become more independent and regain a better quality of life. Furthermore, the load of caregivers would also be reduced.

CASE REPORT

This 37-year-old male was a victim of intracranial hemorrhage over the right putamen and thalamus with rupture into the ventricle. He had no significant underlying medical problems, cranial nerve involvement, or sensory function impairment. However, severe motor function impairment and left-sided hemiplegia with Brunnstrom stage II was noted. It was difficult for him to perform basic activities of daily living (Barthel index= 35, severe dependence). Besides, acute renal function impairment with elevated serum blood urea nitrogen (BUN) and creatinine (Table 1) was noted during admission to the rehabilitation ward. Re-catheterization of Foley tube was performed for relieving excessive post-voiding urine retention, of volumes up to 300 ml as determined by Bladder Scan. Bilateral hydronephrosis was imaged by renal sonography and neurogenic overactive bladder with outlet obstruction was found by urodynamic studies.

Under fluid resuscitation and indwelling catheter drainage, his renal function recovered to baseline (Table 1). However, the indwelling catheter made it inconvenient to perform activities of daily living and rehabilitative exercises. Furthermore, poor hemiplegic limb function, unbalanced trunk, and insufficient family support made it impossible for him to do CIC.

Based on the concept of functional orthosis, we tried to find a device to assist this patient in performing CIC with one-sided limbs by himself. Two novel devices were designed to aid him in performing CIC (Figure 1). After education and training, he could achieve the whole procedure of CIC alone (Figure 2), and the residual urine

volume decreased to within normal limits (Table 2).

DISCUSSION

Bladder dysfunction is common in stroke patients. Detrusor hyperreflexia with uninhibited bladder contraction is the most common urodynamic finding following stroke.^[15-19] Proper diagnosis and management of voiding dysfunction in the stroke patient are important for improved patient wellbeing, increased patient survival, and decreased disability.^[20]

The patient presented here is a stroke patient with left hemiplegia. Due to bladder dysfunction and poor caregiver support, he had to catheterize himself with CIC. Before testing some devices that could assist this patient in performing CIC, we determined that success for a hemiplegic patient would have to complete two major steps of CIC: (1) preparing CIC equipment and materials; and (2) inserting the catheter into urethral orifice. With this in mind, we designed orthoses to assist this patient in overcoming these possible problems.

First, for helping this patient to prepare CIC equipments and materials, a scaffold was designed for holding the catheter so that he could stabilize and sterilize the catheter on the scaffold with one hand (Figure 1, A). Second, when inserting the catheter, a platform was designed for placing and stabilizing the patient's penis so as to spare his functional hand for catheterization (Figure 1, B).

In the beginning, due to unfamiliarity with the new method of CIC, the patient could not drain his bladder as effectively as expected. However, after familiarizing himself with single-handed orthoses-assisted CIC, there was a marked improvement in the effect of bladder drainage (Table 2). As a result, this hemiplegic patient could effectively perform CIC by himself with these novel orthoses.

Our experience with this new CIC procedure has led us to the determination of some minimal requirements for orthoses-assisted CIC: (1) good trunk balance: the further a patient can bend forward, the better the achieved effect of CIC; (2) ipsilateral limb function, especially of the hand, is prerequisite for this new CIC procedure which is actually more challenging than traditional CIC; and (3) good cognitive function: as mentioned previously, performing one-handed CIC with these novel devices re-

quires education and practice.

Although several complications such as urethral intolerance and urinary tract infection have been reported as CIC disadvantages,^[21,22] CIC is still an effective therapeutic option for the treatment of dysfunctional bladder with

large post-voiding urine retention. For reducing complications such as renal failure, upper urinary tract deterioration, and urosepsis, this technique has been considered the first-line treatment for managing urinary retention caused by neurogenic bladder.^[23]

Table 1. Serum BUN and Creatinine level

Day after onset	Day4	Day10	Day13	Day16*	Day19	Day26
BUN (mg/dl)	49.6	26.6	60.9	108	47.7	31.9
Cr. (mg/dl)	3.9	3.1	4.1	5.7	4.0	3.9

* The day of inserting indwelling catheter

Table 2. Effectiveness of intermittent catheterization

Day after onset	D25*	Day30	Day32**	Day33	Day34	Day35
Voiding volume (mL)	400	140	250	150	200	200
Residual urine volume (mL)	146	288	160	130	115	90
Catheterizing volume (mL)			20	100	70	75

*The day of removing indwelling catheter; **The day of beginning intermittent catheterization for neurogenic bladder

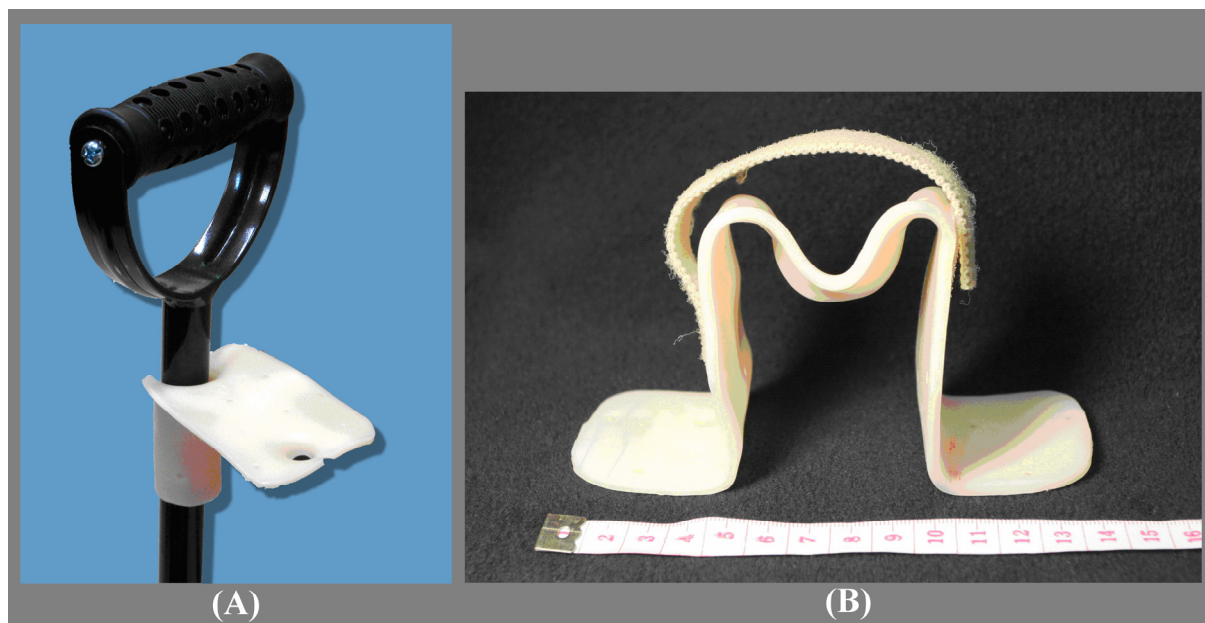


Figure 1. Novel orthoses: (A) A scaffold for holding the catheter has several characteristics: (1) it can be installed on common devices, such as a cane or bedrail; (2) it has a well designed foramen, for easy in-and-out catheter movement and firm grasping; and (3) it provides an appropriate distance between catheter and other devices to avoid contamination. (B) A platform for immobilizing the penis has characteristics such as: (1) a replaceable bandage for stabilization; (2) an extended base for stability between the thighs; and (3) a proper angle, near horizontal, allowing the penis adequate movement in an appropriate direction for reducing discomfort or trauma during catheter insertion.

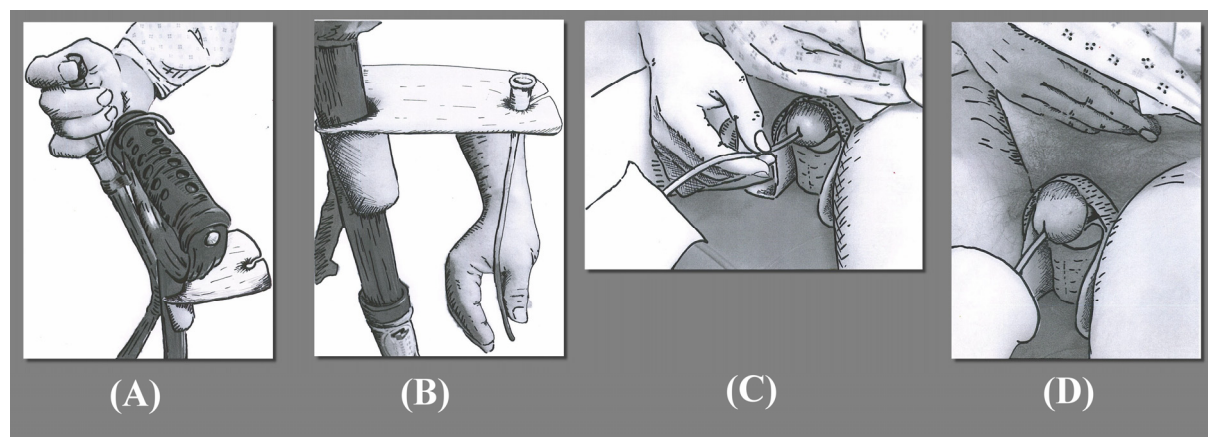


Figure 2. Using two novel orthoses, a hemiplegic patient could perform intermittent catheterization by one hand smoothly and effectively. (A) Preparing CIC equipment and materials by single-handed procedure. (B) Patient could put catheter on the scaffold and clean it. (C) The platform could immobilize patient's penis and free his sound hand to perform catheterization. (D) Forward tilting and Crede's maneuver for facilitating bladder emptying.

CONCLUSION

In our case here, orthoses have been applied to assisting musculoskeletal impairment for relief of some physical or organic disorder. As our case demonstrates, use of these orthoses can be extended to the entire population of male hemiplegic patients with neurogenic bladder. In the future, these patients may be capable of performing one-handed CIC under the assistance of the novel orthoses to achieve adequate bladder drainage.

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協助男性偏癱患者施行間歇性導尿之新型輔具： 病例報告

蔡玉麟¹ 黃茂雄^{1,2} 陳嘉炘^{1,2}

高雄醫學大學附設中和紀念醫院復健科¹ 高雄醫學大學醫學系²

神經性膀胱症(neurogenic bladder)指的是外傷或內因性神經疾病所導致的膀胱機能異常。間歇性導尿(clean intermittent catheterization)能有效降低神經性膀胱症所產生的腎水腫、膀胱輸尿管逆流、泌尿道結石等併發症；其擁有較高的接受度也有助於患者心理社會層面的康復。一般的間歇性導尿技術需在健全的雙手及良好的軀幹平衡能力下才能順利執行，但腦中風患者或有半側癱瘓的問題，將使得間歇性導尿的執行有很大的障礙。本例為一個 37 歲男性，罹患顱內出血合併左側肢體癱瘓及神經性膀胱症。在照顧者協助下，患者先以間歇性導尿的方式來緩解尿液滯留的問題。但由於照顧者無法隨侍照料，該病患亟欲尋求可用單側肢體獨立完成間歇性導尿的方法。利用熱塑性素材設計出兩個輔助裝置來克服患者執行間歇性導尿時可能遇到的障礙：導尿管支架可用來放置導尿管，輔助患者用單手來拿取、清潔、與收納導尿管。擺位平台則可用來固定患者陰莖，使患者能用單手將導尿管插入尿道。經過適當的衛教，患者逐漸熟練使用輔具來執行間歇性導尿，使餘尿量有效降至 20mL 以下。即便坐在輪椅上，該患者仍能順利完成執行間歇性導尿，並順利出院接受門診追蹤與治療。臨床上，輔具可以幫助患者將剩餘的運動功能更有效率地發揮，代償失去的運動功能。在此案例，輔具的概念與效益延伸到生理機能障礙的緩解，使患者避免生理功能障礙的併發症，並獲得更好的生活品質與心理社會功能。（台灣復健醫誌 2010；38(3)：175 - 180）

關鍵詞：神經性膀胱症(neurogenic bladder)，間歇性導尿(intermittent catheterization)，輔具(orthosis)，腦中風(stroke)