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The Effect of Video-Assisted Clean Intermittent Catheterization Training in Children on Urinary Catheterization Competency

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ABSTRACT

Background and Objective: Intermittent catheterization in patients with neurogenic or dysfunctional bladder can be quite distressing. Implementing any intervention to decrease or prevent catheter-associated urinary tract infections (CAUTIs) is highly significant. Therefore, the present study was conducted to evaluate the effect of video-assisted clean intermittent catheterization training in children on urinary catheterization competency.

Methods: This quasi-experimental study was conducted on 199 medical students (interns and clinical clerks). Initially, a pretest was administered to the learners regarding standard catheterization principles, consisting of 5 key questions with a maximum score of 5, which covered essential points including preparation, procedure, and post-catheterization care. Then, a 6-minute educational video was shown to the learners, in which all the above-mentioned points were demonstrated by a skilled nurse in a clinical setting (examination bed) on a real patient (a child). Then, a post-test was administered to the learners after 29 days, and pre- and post-test scores were compared. Additionally, learner satisfaction was assessed using a satisfaction questionnaire comprising 7 questions based on a 5-point Likert scale (very low, low, moderate, high, very high).

Findings: The mean score increased from 0.89±0.49 in pretest to 2.90±1.15 in post-test ($p<0.001$). Approximately 78% of learners reported "high" and "very high" satisfaction with the use of video as a supplementary educational tool for learning clean intermittent catheterization skills and were thoroughly satisfied.

Conclusion: The study results demonstrated that the use of standard educational videos is a highly efficient and effective supplementary tool for improving skill levels and achieving satisfaction of medical learners in the learning cycle of specialized clean intermittent catheterization skills.

Keywords: *Clean Intermittent Catheterization, Video-Assisted Learning, Clinical Competency, Learner Satisfaction.*

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Introduction

Neurogenic bladder represents a form of lower urinary tract symptom resulting from damage or pathology affecting the central or peripheral nervous system, which impairs adequate urine storage and voiding (1). Without treatment, this condition can lead to urinary complications or urinary incontinence in as many as 70% of patients during the early years of life (2). In this context, the advent of clean intermittent catheterization has greatly facilitated the clinical management of neurogenic bladder patients. Evidence indicates that clean intermittent catheterization decreases urinary tract infections in patients with neurogenic bladder, promotes renal function preservation, and over the long term improves upper urinary tract dilation, serum creatinine levels, and the severity of vesicoureteral reflux (3, 4).

Clean intermittent catheterization improves body image and self-esteem in affected individuals. Furthermore, by ameliorating the signs and symptoms of incontinence and urinary tract infection, as well as ensuring adequate voiding in patients with neurogenic bladder (5), it can facilitate the restoration of patient independence and quality of life in individuals with neurogenic bladder (6). The initial approach to clean intermittent catheterization is often undertaken during hospitalization, as an integral component of patient care, enabling the patient to gradually learn this technique correctly (7). Patients who encounter fewer difficulties during catheterization-such as pain, sensation of obstruction, and urinary incontinence-demonstrate greater willingness to continue and adhere to clean intermittent catheterization. Moreover, measures aimed at reducing or preventing catheter-associated urinary tract infections are of great importance, as they prevent prolonged hospitalization and the development of potential complications (8, 9). In this regard, emphasis on proper training and execution of catheterization technique, appropriate catheter size selection, and ensuring adequate lubrication by caregivers and medical staff can be highly beneficial (9).

Studies have demonstrated that practical skills can be taught using a standardized method within a controlled learning environment by utilizing video, resulting in better learning outcomes, higher levels of self-confidence, and improved comprehension and skill development among learners (10, 11). Educational videos allow learners to control the pace and sequence of information intake and repeatedly watch the steps of clinical skills at their own speed. This also enhances comprehension (12). High-quality videos can increase learner satisfaction and improve engagement with the material. They also play an important role in knowledge retention and understanding (13). Learners have identified videos as their preferred educational format due to their flexibility and capacity for self-directed learning (14). Caregivers and learners can overcome challenges encountered during clean intermittent catheterization instruction by using video resources that present this skill in a simplified and clear manner (15, 16).

Although previous research indicates that video-based instructions, compared to traditional teaching methods, enhance knowledge retention and application across a wide range of general and specialized medical skills, there are limited studies regarding the effectiveness of video-based training for teaching the specialized skill of clean intermittent catheterization to medical students (17-19). Most recent studies have focused on training patients or nursing students (20). Therefore, this study was conducted with the aim of evaluating the effect of practical clean intermittent catheterization training in children on the acquisition of specialized skills by learners.

Methods

This quasi-experimental study was conducted on 199 medical students (interns and clinical clerks) after approval by the Ethics Committee of Babol University of Medical Sciences (code:

IR.MUBABOL.REC.1404.171). Initially, a pretest was administered to the learners regarding standard catheterization principles, consisting of 5 key questions with a maximum score of 5, which covered essential points including preparation, procedure, and post-catheterization care. Subsequently, a 6-minute educational video was shown to the learners, in which all the above-mentioned points were demonstrated by a skilled nurse in a clinical setting (examination bed) on a real patient (a child) to achieve maximum alignment with real-life conditions. The structure of the video (Figure 1) consisted of three main sections:

Preparation: Introduction of necessary equipment (appropriate-size Nelaton catheter, lubricant gel, receiver), instruction on preparing a homemade antiseptic solution for catheter storage (including normal saline, povidone-iodine, and white vinegar), and emphasis on the importance of hand hygiene and perineal cleansing.

Procedure: Practical demonstration of proper catheterization technique while adhering to aseptic principles (without the need for sterile gloves), method of catheter lubrication with gel, appropriate angle and pressure during catheter insertion to prevent trauma, and management of complete bladder emptying.

Post-catheterization care: Instruction on the safe removal of the catheter, re-washing the catheter with soap and water, and proper storage in the prepared solution for subsequent use (up to 24 hours).



Figure 1. Key steps demonstrated in the educational video on clean intermittent catheterization: (A) Equipment preparation: Display of required instruments, including Nelaton catheter, gel, receiver, and preparation of catheter storage solution (mixture of normal saline, povidone-iodine, and white vinegar). (B) Catheter insertion technique: Proper method of holding and inserting the lubricated catheter into the urethra, with emphasis on avoiding excessive force. (C) Urine drainage: Demonstration of urine flow into the receiver and emphasis on waiting until the last drop of urine exits to ensure complete bladder emptying. (D) Washing and storage: Instructions on how to wash the catheter after use and place it in a container containing disinfectant solution for reuse.

In the production of this video, techniques such as subtitling key points, utilizing close-up shots to display sensitive details, and providing clear narration during the procedure were employed to manage learners' cognitive load and facilitate deep learning. Additionally, student satisfaction was assessed using a video-based instruction satisfaction questionnaire. This teaching satisfaction questionnaire, whose validity and reliability had been confirmed in previous studies, consists of 7 questions designed on a 5-point Likert scale (very low, low, moderate, high, very high) (21). After 29 days, a post-test was administered to the learners, and pre- and post-test scores were compared. Data were analyzed using SPSS software version 20 and paired t-test, with $p<0.05$ considered statistically significant.

Results

The mean pretest score was 0.89±0.49, which increased to 2.90±1.15 after the intervention ($p<0.001$). In assessing student satisfaction with this educational method, the results demonstrated that learners received the instructional videos very favorably. Specifically, 98 students reported their satisfaction level as "very high," 57 students reported "high" satisfaction, 35 participants reported "moderate" satisfaction, and only 9 participants reported "low" satisfaction.

Overall, the results indicated that approximately 78% of medical students participating in this study had "high" and "very high" satisfaction with using video as a supplementary educational tool for learning intermittent catheterization skills and were completely satisfied.

Discussion

The results of this study demonstrated that the video-based educational intervention led to a significant and remarkable increase in student scores. Furthermore, the results showed that 78% of students were completely satisfied with this method. The substantial improvement in student skills in this study aligns with findings from previous research that have confirmed the effectiveness of multimedia education in medical sciences (22, 23). The mechanism through which educational films enhance learning and memory in medical students can be explained by the interaction of two fundamental theories: the Cognitive Theory of Multimedia Learning (CTML) and the Cognitive Load Theory (CLT). According to CTML, deep learning occurs when learners receive and process information through two separate visual and auditory channels. By activating both channels simultaneously, educational films lead to the formation of stronger mental representations compared to single-channel instruction, such as text alone (24, 25). Furthermore, standard educational videos prevent working memory overload by employing principles such as segmenting content into small chunks and highlighting key points. This also facilitates cognitive load management by allowing the learner to control playback speed (11).

The results of this study also showed that the video-based educational intervention led to a significant increase in student skill scores, from 0.89 in the pretest to 2.90 in the post-test, representing an approximate three-fold increase in raw scores. This increase is substantially greater than that observed in similar studies. In the study by Fang et al., student scores in an online heart auscultation course increased from 40 to 70 (a 1.75-fold increase) (26). The reason for this discrepancy can be attributed to the learners' low baseline knowledge regarding the specialized skill of clean intermittent catheterization compared to more general skills, which allowed the educational intervention to demonstrate a greater numerical effect.

In a study aiming to evaluate the effect of video-based training on practical skills and anxiety levels of nursing students in range of motion exercises, Melikoğlu et al. concluded that the use of educational videos can help improve students' practical skills in range of motion exercises. Although the effect on anxiety levels was not statistically significant, educational videos can still serve as a supplementary tool alongside traditional teaching methods (23).

Regarding satisfaction, 78% of participants in the present study reported their satisfaction at high and very high levels, which is consistent with the results of Agha et al., who reported an 85% satisfaction rate among medical students who received simulation-based learning (27). This finding aligns with the outcomes of a recent systematic review demonstrating that levels of interaction and satisfaction with digital clinical skills education are enhanced among students and learners (28). Furthermore, another systematic review by Hansen et al. found that in 73% of the studies reviewed, the use of video animations led to significant improvements in health information recall and patient satisfaction, which corresponds with the results of our study (29). The primary reason for this high satisfaction can be found in the CTML, where the simultaneous combination of visual and auditory information manages cognitive load and makes learning more engaging. Additionally, videos allow the students to observe and analyze procedural steps without the stress of being at the bedside of a real patient and the fear of making errors, which consequently leads to higher confidence and satisfaction (30). Although online videos are effective for teaching clinical skills, they are not a complete substitute for practical instruction. Repeatedly watching a video without physical practice can lead to an illusion of competence, and the learner assumes a higher skill level than they actually possess (31). Instead, online videos should be integrated as a component of the practical skills learning cycle (32).

Overall, the findings of this study indicate that the design and implementation of standard educational videos serve as a highly efficient and effective supplementary tool for improving theoretical knowledge levels and achieving satisfaction among medical students in the learning cycle of specialized skills such as clean intermittent catheterization.

Limitations of the present study include its quasi-experimental (pretest/post-test) design without a control group. Furthermore, this study only measured theoretical knowledge and satisfaction, and no practical skill assessment was conducted. Therefore, it is recommended that future studies include an assessment of practical skills.

Conflict of interest: The authors declare that there is no conflict of interest.

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