Journal of Digital Convergence, vol. 19, no. 12, pp. 649–660, 2021 · ISSN 2713-6434 eISSN 2713-6442 · https://doi.org/10.14400/JDC.2021.19.12.649

케어비데로봇을 이용한 배설간호가 중환자실 환자의 실금관련피부염, 욕창위험도, 생리학적 지표에 미치는 효과

The Effects of a CareBidet Robot for Defecation Care on Incontinence-Associated Dermatitis, Pressure Ulcer Risk and Physiological Markers in Critical Care Patients

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Abstract

The purpose of this study was to examine the effects of defecation care provided by a CareBidet robot on incontinence-associated dermatitis (IAD), pressure ulcer risk, and physiological markers (serum albumin, total protein and lymphocyte fraction) in patients admitted to an intensive care unit (ICU). A non-equivalent control-group pre-test / post-test quasi-experimental design was used. Fifty-five ICU patients aged 20–70 years without pre-existing gastrointestinal disorders or incontinence were allocated to an experimental group (n = 27), who received defecation care with a Curaco CareBidet robot providing automatic detection, aspiration, warm-water cleansing and warm-air drying, or a control group (n = 28), who received standard wet-wipe cleansing followed by air drying. Outcomes were measured at baseline and again on days 3, 5 and 7. Repeated-measures analysis of variance revealed significant Group × Time interactions for IAD ($F = 25.65$, $p < .001$), pressure ulcer risk on the Braden scale ($F = 54.91$, $p < .001$), serum albumin ($F = 20.12$, $p < .001$) and serum lymphocyte fraction ($F = 8.74$, $p = .003$); total protein was not significant ($F = 0.50$, $p = .484$). Defecation care with the CareBidet robot therefore attenuated the progression of IAD, preserved skin integrity as reflected in the Braden score, and was associated with more favourable nutritional and immunological trajectories than standard manual care.

Keywords: *CareBidet robot, incontinence-associated dermatitis, pressure ulcer, Braden scale, intensive care nursing*

1. Introduction

Incontinence-associated dermatitis (IAD) is a form of irritant contact dermatitis that arises when the skin is repeatedly exposed to urine or faeces. Prolonged contact with moisture, faecal enzymes and irritating chemicals produces erythema, maceration and, in severe cases, superficial denudation. IAD is estimated to affect roughly half of all incontinent patients and is a well-established risk factor for the development of pressure ulcers, because the two conditions share anatomical distribution, high-risk populations and reinforcing pathophysiology. Although IAD (a chemical injury) and pressure ulcers (a mechanical injury from pressure or shear) are distinct entities, they are often confused in practice.

Robotic technologies have progressively entered medical and nursing practice, but robot-assisted defecation care has rarely been evaluated in intensive care populations, who arguably have the greatest need. The present study therefore assessed whether defecation care delivered with a CareBidet robot reduces IAD and pressure ulcer risk and improves physiological markers in ICU patients, thereby providing evidence to inform nursing guidelines and reimbursement policy.

2. Methods

2.1 Study design

The study used a non-equivalent control-group pre-test / post-test quasi-experimental design to compare defecation care delivered with the CareBidet robot with standard manual defecation care.

2.2 Participants

Participants were ICU patients aged 20–70 years admitted to a tertiary general hospital in Seongnam. Exclusion criteria were pre-existing gastrointestinal disorders and pre-existing urinary or faecal incontinence.

2.3 Hypotheses

Three hypotheses were tested: (H1) the experimental group would develop less IAD than the control group; (H2) the experimental group would show a lower pressure ulcer risk on the Braden scale; and (H3) the experimental group would exhibit more favourable physiological markers (serum albumin, total protein, haemoglobin and lymphocyte fraction).

2.4 Instruments

IAD severity was assessed with the Diaper Dermatitis Scale (Brian et al.). Pressure ulcer risk was rated on the Braden scale. Physiological markers (serum albumin, total protein, haemoglobin and lymphocyte fraction) were obtained from routine laboratory tests.

2.5 Data collection

Data were collected between 25 December 2020 and 31 March 2021.

2.6 Intervention

Each experimental-group patient was fitted with a dedicated Curaco CareBidet robot (one device per patient). The device automatically detected excreta, aspirated the waste, delivered warm-water cleansing, and completed a warm-air drying cycle. Control-group patients received manual cleansing with disposable wet wipes followed by natural air drying, according to the unit’s standard care protocol.

Fig. 1. CONSORT-style flow diagram of the trial

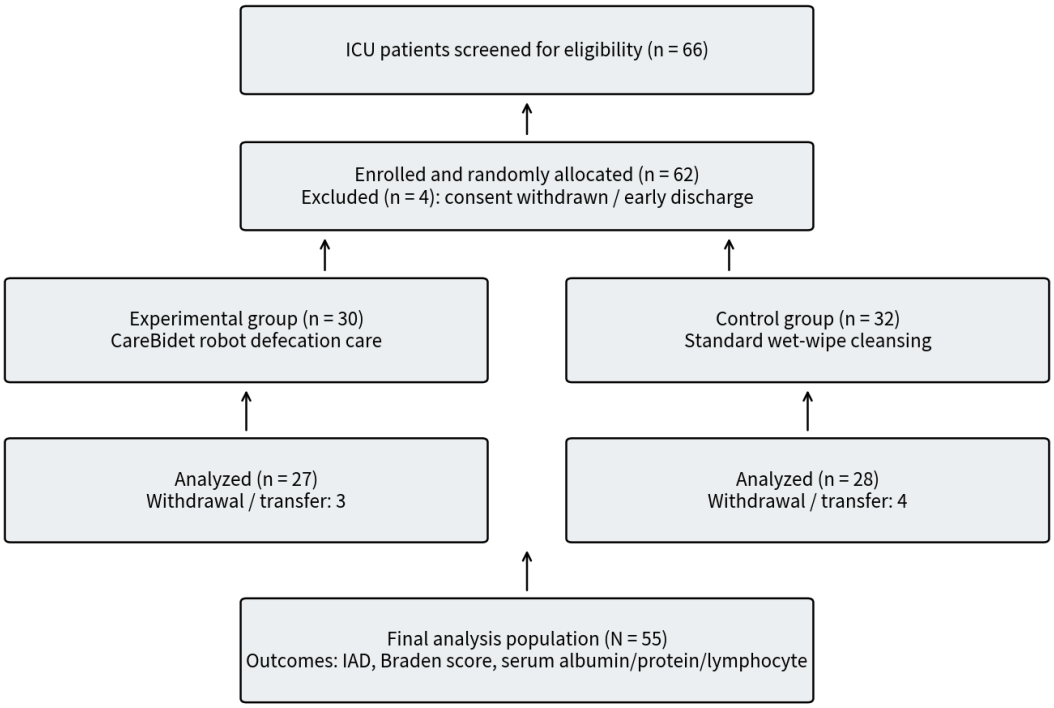

Fig. 1. Flow diagram of the trial (enrolment, allocation, follow-up and analysis).

3. Results

3.1 Homogeneity of baseline characteristics

Table 1. Homogeneity of baseline characteristics (N = 55).

Variable	Category	Experimental (n = 27) n (%) / M ± SD	Control (n = 28) n (%) / M ± SD	χ^2 / t / Z	p
Age (years)	20–30	1 (3.2)	1 (3.2)		
	31–40	5 (18.5)	4 (14.3)		
	41–50	5 (18.5)	6 (21.4)		
	51–60	9 (33.3)	11 (39.3)		
	61–70	7 (25.9)	6 (21.4)	0.13	.971
Sex	Male	11 (40.7)	13 (46.4)		
	Female	16 (59.3)	15 (53.6)	0.07	.787
BMI (kg/m²)	<20	6 (22.2)	7 (25.0)		
	20–25	16 (59.3)	14 (50.0)		
	>25	5 (18.5)	7 (25.0)	0.40	.820
Smoking	Non-smoker	14 (51.9)	10 (35.7)	1.16	.282
Primary diagnosis	Cancer	5 (18.5)	7 (25.0)		
	Neurological	15 (55.6)	11 (39.3)		
	Spinal	5 (18.5)	8 (28.6)		

	Other	1 (3.7)	2 (7.1)	2.07	.557
Length of hospital stay (days)	M ± SD	42.78 ± 13.74	36.46 ± 20.23	0.73	.469
ICU stay (days)	M ± SD	12.68 ± 8.34	14.36 ± 10.84	−0.88	.379

3.2 Homogeneity of dependent variables at baseline

Table 2. Pre-test homogeneity of dependent variables between groups (N = 55).

Variable	Experimental M ± SD	Control M ± SD	t / Z	p
IAD score	0.63 ± 0.56	0.43 ± 0.50	−1.31	.212
Braden score	19.22 ± 1.53	19.29 ± 1.49	−0.16	.876
Serum albumin (g/dL)	2.67 ± 0.79	2.72 ± 0.78	−0.22	.824
Total protein (g/dL)	6.34 ± 0.79	6.72 ± 0.95	−1.60	.115
Lymphocyte (%)	9.76 ± 2.08	10.24 ± 1.92	−0.17	.990

3.3 Hypothesis testing

Repeated-measures ANOVA yielded significant Group × Time interactions for IAD, Braden score, serum albumin and lymphocyte fraction, supporting hypotheses H1, H2 and the albumin and lymphocyte components of H3. Total protein did not show a significant interaction.

Table 3. Repeated-measures ANOVA — Group, Time and Group × Time effects (N = 55).

Variable	Group F (p)	Time F (p)	Group × Time F (p)
IAD	282.68 (<.001)	38.02 (<.001)	25.65 (<.001)
Braden score	17.40 (<.001)	42.50 (<.001)	54.91 (<.001)
Serum albumin	27.42 (<.001)	4.13 (.047)	20.12 (<.001)
Total protein	21.08 (<.001)	5.03 (.029)	0.50 (.484)
Lymphocyte	ns	ns	8.74 (.003)

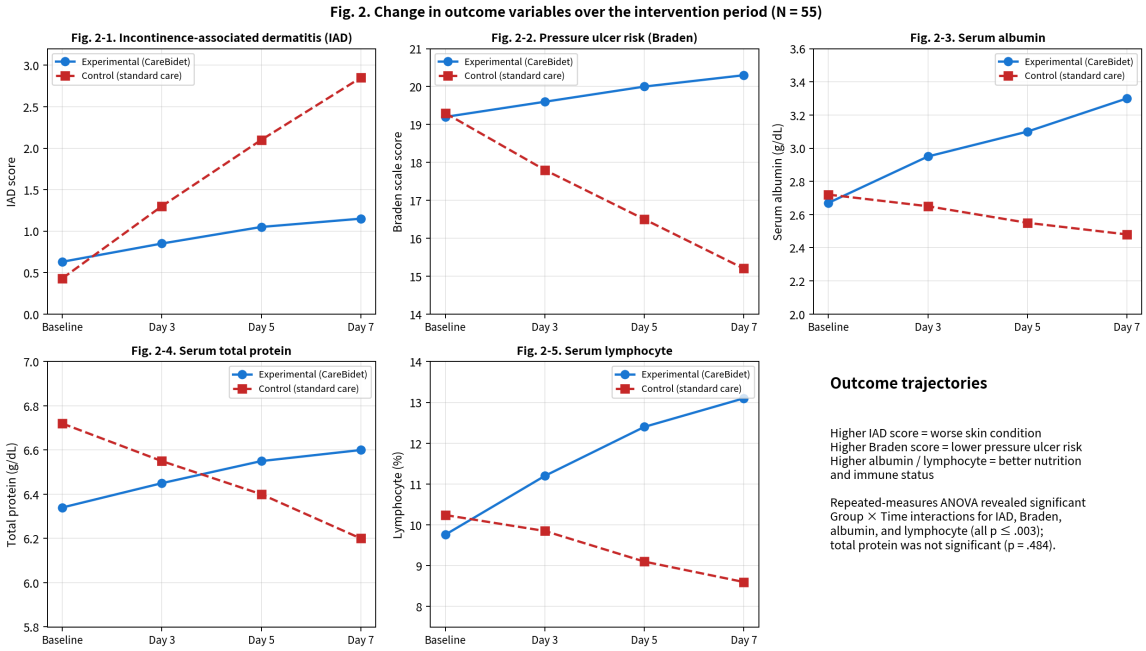

Fig. 2. Trajectories of the outcome variables (IAD, Braden score, serum albumin, total protein and lymphocyte fraction) over the intervention period.

4. Discussion

Defecation care delivered with the CareBidet robot was associated with a slower rise in IAD score, a stable Braden score, and more favourable albumin and lymphocyte trajectories than standard manual care. Because IAD typically emerges within 2–3 days of prolonged exposure and worsens by days 4–5, the immediacy of automated cleansing appears to be a key mechanism: the robot removes urine and faeces within seconds of detection, markedly limiting the duration of chemical exposure. The physiological improvements observed alongside the skin outcomes are consistent with reduced systemic stress from cutaneous inflammation and with more consistent hygiene management during the acute care period. The findings support the incorporation of robot-assisted defecation care into ICU nursing protocols and provide an evidence base for its inclusion in health-insurance fee schedules for wound and skin nursing.

5. Conclusion

Robot-assisted defecation care using the CareBidet system was effective in reducing IAD, in lowering pressure ulcer risk on the Braden scale, and in producing more favourable serum albumin and lymphocyte trajectories in ICU patients. Multicentre confirmatory trials and integration of the intervention into undergraduate fundamental nursing curricula are recommended.

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