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ORIGINAL RESEARCH

Hydrocolloid versus Liquid Dressings for Incontinence-Associated Dermatitis: A Clinical Evaluation in Critically Ill Patients

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Objective: The aim of this study was to compare the clinical efficacy of liquid and hydrocolloid dressings in the management of incontinence-associated dermatitis (IAD) among critically ill patients and to evaluate their effects on skin lesion healing, symptom improvement, and complication prevention.

Methods: A total of 136 critically ill patients diagnosed with IAD and admitted to the hospital between January 2023 and January 2024 were included. Patients were randomly assigned using the random number table method to the hydrocolloid dressing group (n = 68) or the liquid dressing group (n = 68). The hydrocolloid dressing group received DuoDERM® hydrocolloid dressing, while the liquid dressing group received 3M™ Cavilon™ liquid dressing. Outcomes assessed included the Scoring Atopic Dermatitis (SCORAD), Dermatology Life Quality Index (DLQI), Perineal Assessment Tool (PAT) score, Visual Analogue Scale (VAS), skin lesion healing time, recurrence rate, and complications. Measurements were recorded before and after treatment, and clinical efficacy was evaluated.

Results: Following treatment, SCORAD, DLQI, PAT, and VAS scores decreased significantly in both groups compared with baseline (all $p < 0.05$). SCORAD, PAT, and VAS scores in the hydrocolloid dressing group were significantly lower than those in the liquid dressing group, while the DLQI scores were higher (all $p < 0.05$). In addition, the hydrocolloid dressing group demonstrated a shorter skin lesion healing time, lower recurrence rate, and reduced overall complication rate (all $p < 0.05$). The difference in clinical efficacy between the two groups was statistically significant, favoring the hydrocolloid dressing group ($p < 0.05$).

Conclusion: For critically ill patients with IAD, hydrocolloid dressings demonstrated superior efficacy compared with liquid dressings. Hydrocolloid dressings promoted faster healing of skin lesions, decreased recurrence and complication rates, and improved overall clinical outcomes.

Keywords: critical illness, hydrocolloids, incontinence-associated dermatitis, liquid dressing, rapid healing

Introduction

Incontinence-associated dermatitis (IAD) is a common complication among critically ill patients, primarily caused by prolonged exposure of the skin to moisture, irritants in urine and feces, capillary hypoperfusion, malnutrition, and frailty. The incidence of IAD is higher in this population, with approximately 30% of the patients in the intensive care unit (ICU) experiencing skin problems related to urinary or fecal incontinence.[1–3] Clinical management emphasizes prevention and early intervention, including regular replacement of disposable absorbent underpads or sheets, maintaining skin cleanliness and dryness, and appropriate use of skin care products. Timely assessment and adjustments of care strategies are also essential.[4]

Previous studies have shown that critically ill patients are particularly susceptible to skin injury and incontinence due to long-term bed rest or physiological dysfunction, making IAD a common but difficult-to-treat complication.[5] Conventional treatments have demonstrated limited effectiveness, underscoring the need for therapeutic approaches that support faster and more effective healing. In recent years, liquid and hydrocolloid dressings have gained widespread clinical application as

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barrier products for the management of IAD in critically ill patients.[6–9] Both dressings are beneficial for promoting wound healing, reducing infection risk, and alleviating pain due to their unique physical and chemical properties. However, evidence comparing their efficacy in critically ill patients with IAD remains limited, and no consensus exists on which approach yields better clinical outcomes. Therefore, in this randomized controlled trial, we aimed to compare the clinical efficacy of liquid and hydrocolloid dressings in the treatment of IAD among critically ill patients. The study evaluated outcomes related to skin lesion healing, symptom improvement, quality of life, and complication rates, with the aim of providing evidence to guide the selection of optimal skin care strategies in clinical practice.

Participants and Methods

Research Participants and Design

This prospective randomized controlled study included 136 critically ill patients diagnosed with IAD who were admitted to the hospital between January 2023 and January 2024. Participants were randomly allocated into two groups using the random number table method: the hydrocolloid dressing group (n = 68) and the liquid dressing group (n = 68). In the hydrocolloid dressing group, patient age ranged from 35 to 65 years, with a mean age of 47.50 ± 14.25 years. In the liquid dressing group, patient age ranged from 36 to 65 years, with a mean age of 47.97 ± 13.78 years. No statistically significant differences were observed between the two groups regarding sex, age, disease duration, comorbidities, or severity of IAD ($p > 0.05$), indicating comparability of baseline characteristics. This study was reviewed and approved by the hospital's Ethics Committee, and informed consent was obtained from patients and their family members before enrollment.

Diagnosis and Inclusion Criteria

(1) Patients classified as critically ill; (2) Patients meeting the diagnostic criteria for IAD as defined in "New Dermatology Diagnosis: Incontinence-Associated Dermatitis".[10]

Exclusion Criteria

(1) Presence of infectious diseases, malignant tumors, or cognitive dysfunction; (2) Use of other skin barrier protectants within 24 hours prior to enrollment; (3) Known allergy to any component of the dressings used in this study; (4) Incomplete clinical data or loss to follow-up.

Methods

All patients in both groups received standard basic care for IAD, which included regular cleansing of the perianal and perineal skin using a pH-neutral mild cleansing solution, gentle drying with a soft cotton towel, and avoidance of vigorous wiping. In addition to this care, group-specific dressings were then applied.

Liquid Dressing Group

Patients in the liquid dressing group were treated with 3M™ Cavilon™ No-Sting Barrier Film (Solventum, USA). The intervention protocol consisted of the following steps: (1) Preparation of materials: 3M liquid dressing, sterile gloves, antiseptic solution, and disposable absorbent underpads were prepared. (2) Skin preparation: Hand hygiene was performed, sterile gloves were worn, and aseptic conditions were maintained. The perilesional skin was gently cleansed with 0.9% sodium chloride solution to ensure cleanliness and minimize irritation. (3) Application of liquid dressing: The 3M liquid dressing was shaken well, then applied evenly to the affected skin using a sterile cotton ball, ensuring complete coverage of injured areas and surrounding edges. (4) Fixation and protection: A breathable non-adhesive dressing was applied to cover the treated area, providing protection and stabilization. (5) Replacement: The treated area was inspected regularly, and the dressing was replaced every 7 days or sooner if containment or detachment occurred, until complete recovery.

Hydrocolloid Dressing Group

Patients in the hydrocolloid dressing group were treated with DuoDERM® Extra Thin hydrocolloid dressings (Model: 33533, Coloplast, Denmark). The intervention protocol consisted of the following steps: (1) Preparation of materials:

DuoDERM hydrocolloid dressing, sterile gloves, antiseptic solution, and disposable absorbent underpads were prepared. (2) Skin preparation: Hand hygiene was performed, sterile gloves were worn, and aseptic conditions were maintained. The perilesional skin was gently cleansed with 0.9% sodium chloride solution to ensure cleanliness and minimize irritation. (3) Application of hydrocolloid dressing: The dressing was cut to an appropriate size according to the lesion area and gently applied to the affected skin, ensuring complete coverage and firm adherence without wrinkles or excessive tension. (4) Fixation and protection: A breathable protective dressing was placed over the hydrocolloid layer to maintain a moist environment and ensure stable fixation. (5) Replacement: The wound was inspected daily for signs of infection, exudation, or dressing detachment. Dressings were replaced every 7 days, or sooner if excessive exudation occurred, until complete recovery.

Observation Indicators

Scoring Atopic Dermatitis (SCORAD) Score[11]

The SCORAD index was used to evaluate the severity of IAD. The total score ranged from 0 to 50 and was determined based on clinical case information, lesion location, lesion area, lesion severity, pruritus intensity, and patient quality of life. Higher scores indicated greater disease severity, whereas lower scores reflected better recovery.

Dermatology Life Quality Index (DLQI) Score[12]

The DLQI questionnaire was used to assess the impact of skin disease on patients' quality of life. It contains 10 items covering domains such as physical functioning, emotional well-being, and daily activities. Each item was scored on a scale from 0 to 3, with higher scores indicating greater impairment. The body is divided into four regions—head and neck (10%), upper limbs (20%), trunk (30%), and lower limbs (40%)—to account for proportional surface area. Lower total scores indicated better recovery.

Perineal Assessment Tool (PAT) Score[13]

The PAT score was used to evaluate perineal skin conditions, including lesion characteristics, pain intensity, exudate level, and overall skin changes. Higher scores indicate more severe conditions, whereas lower scores reflect improved outcomes.

Visual Analogue Scale (VAS) Score

Pain severity was assessed using the VAS, a 0 to 10 visual analogue scale based on patients' subjective perception of pain.[14] Lower scores indicate reduced pain intensity.

Healing Time of Skin Lesions and Recurrence Rate

Daily observations were conducted to document the healing time of skin lesions. After completion of the intervention, patients were followed for 2 months, and recurrence of lesions was recorded.

Complications

Complications occurring during the intervention period, including local infections, new pressure ulcers, and contact dermatitis, were recorded.

Evaluation of Treatment Effect

Treatment effectiveness was determined based on clinical criteria: Ineffective: No significant symptom improvement or worsening of symptoms; Effective: Symptom improvement without evidence of infection. Markedly effective: Complete lesion healing without complications; Total effective rate = (markedly effective + effective) / total number of cases × 100%.

Statistical Analysis

All data were analyzed using SPSS v22.0. Normally distributed measurement data were expressed as mean ± standard deviation (M ± SD). Independent-samples t-tests were used for comparisons between groups, while paired t-tests were used for within-group comparisons. Categorical data were presented as frequencies and percentages, and intergroup differences were analyzed using the chi-square (χ^2) test. A $p < 0.05$ was considered statistically significant.

Results

Comparison of Changes in SCORAD, DLQI, PAT and VAS Scores

Before treatment, there were no significant differences between the hydrocolloid and liquid dressing groups in SCORAD, DLQI, PAT, or VAS scores ($p > 0.05$). After treatment, all scores decreased significantly in both groups compared with baseline ($p < 0.05$). Intergroup comparison showed that patients in the hydrocolloid dressing group had significantly lower SCORAD, PAT, and VAS scores, as well as higher DLQI, than those in the liquid dressing group ($p < 0.05$) (Tables 1–4), indicating better symptom improvement, quality of life, and pain relief.

Healing Time of Skin Lesions and Recurrence Rate

The mean healing time of skin lesions was significantly shorter in the hydrocolloid dressing group than in the liquid dressing group ($t = 40.530$, $p = 0.001$). During the 2-month follow-up, disease recurrence occurred in 1 patient (1.47%) in the hydrocolloid group and 6 patients (8.82%) in the liquid dressing group. The difference in recurrence rates between groups was statistically significant ($\chi^2 = 3.765$, $p = 0.050$) (Table 5), indicating superior sustained recovery with hydrocolloid dressings.

Table 1 Comparison of SCORAD Scores Before and After Treatment [($\bar{x} \pm s$), Points]

Groups	n	SCORAD Score	
		Before Treatment	After Treatment
Hydrocolloid group	68	25.59±2.56	5.03±0.48
Liquid dressing group	68	25.61±2.58	15.23±1.54
t		0.045	52.140
P		0.963	<0.001

Table 2 Comparison of DLQI Scores Before and After Treatment [($\bar{x} \pm s$), Points]

Groups	n	DLQI Score	
		Before Treatment	After Treatment
Hydrocolloid group	68	13.02±1.31	9.87±0.95
Liquid dressing group	68	12.98±1.28	4.65±0.45
t		0.180	40.950
P		0.957	<0.001

Table 3 Comparison of PAT Scores Before and After Treatment [($\bar{x} \pm s$), Points]

Groups	n	Perineal Skin Score	
		Before Treatment	After Treatment
Hydrocolloid group	68	7.39±0.73	2.16±0.20
Liquid dressing group	68	7.41±0.75	5.65±0.59
t		0.157	46.200
P		0.975	<0.001

Table 4 Comparison of VAS Scores Before and After Treatment [($\bar{x} \pm s$), Points]

Groups	n	VAS Score	
		Before Treatment	After Treatment
Hydrocolloid group	68	7.87±0.79	2.01±0.18
Liquid dressing group	68	7.92±0.81	5.67±0.59
t		0.364	48.930
P		0.716	<0.001

Table 5 Healing Time and Recurrence Rate of Skin Lesions ($\bar{x} \pm s$)

Groups	n	Healing Time of Skin Lesions (d)	Recurrence Rate (%)
Hydrocolloid group	68	15.24±1.53	1(1.47)
Liquid dressing group	68	7.01±0.68	6(8.82)
t/χ^2		40.530	3.765
P		0.001	0.050

Comparison of Complications

During the intervention period, fewer patients in the hydrocolloid dressing group experienced complications compared with the liquid dressing group. In the hydrocolloid group, only 1 patient (1.47%) experienced redness and swelling. In the liquid dressing group, 2 patients (2.94%) experienced minor local infection, 1 patient (1.47%) developed a pressure ulcer, and 1 patient (1.47%) had redness and swelling. Overall, the complication rate was lower in the hydrocolloid dressing group than in the liquid dressing group, and the difference was statistically significant ($\chi^2 = 4.781$, $p = 0.028$) (Table 6).

Comparison of Clinical Efficacy

At the end of treatment, the total clinical effective rate was 97.05% (66/68) in the hydrocolloid dressing group, including 35 markedly effective cases and 31 effective cases. Two patients were classified as ineffective. In the liquid dressing group, the total effective rate was 88.23% (60/68), including 32 markedly effective cases and 28 effective cases, with 8 patients classified as ineffective. The total clinical effective rate in the hydrocolloid dressing group was significantly higher than that in the liquid dressing group ($\chi^2 = 3.885$, $p = 0.048$) (Table 7). These findings indicate that hydrocolloid dressings achieved superior overall clinical outcomes compared with liquid dressings in critically ill patients with IAD.

Table 6 Complications During Treatment [n (%)]

Groups	n	Infection	Pressure Ulcer	Redness and Swelling	Complication Rate
Hydrocolloid group	68	0	0	1	1(1.47)
Liquid dressing group	68	2	2	3	7(10.29)
x^2					4.781
P					0.028

Table 7 Clinical Efficacy of Hydrocolloid and Liquid Dressings [n (%)]

Groups	n	Markedly Effective	Effective	Ineffective	Total Effective Rate
Hydrocolloid group	68	35	31	2	66(97.05)
Liquid dressing group	68	32	28	8	60(88.23)
χ^2					3.885
P					0.048

Discussion

IAD is a common skin problem among critically ill patients, primarily resulting from prolonged contact of the skin with urine and feces during long-term diaper use. This exposure can cause redness, swelling, cracking, and pain, which significantly affect patient comfort, daily activities, and sleep.[15,16] Injured skin is highly susceptible to bacterial or other microbial infections, making timely and effective treatment essential. Appropriate interventions can accelerate repair and regeneration of the injured skin, promoting faster recovery and preventing complications.

The effects of 3M liquid dressings and hydrocolloid dressings on the rapid healing of IAD in critically ill patients warrant discussion. As a spray-type acrylate copolymer, 3M liquid dressing forms a transparent and breathable protective film on the skin, providing moisturizing and barrier effects that maintain a moist wound environment and reduce the risk of infection.[17–19] Its non-adhesive and transparent nature allows healthcare professionals to observe the wound without frequent dressing changes. However, some patients may experience allergic reactions or discomfort due to the dressing components, and it may not offer adequate support for deeper or complex wounds.[20,21] The mechanical durability of the film is limited; it can be easily damaged during routine patient movement, repositioning, or hygiene care, requiring repeated application and potentially affecting overall efficacy. Additionally, sufficient time and care are required for the dressing to form a complete film; otherwise, the skin may adhere, causing secondary injury. In cases of excessive wound moisture, the liquid dressing may fail to form an effective protective barrier. In contrast, hydrocolloid dressings conform more effectively to the wound surface, provide superior isolation, maintain moisture, regulate wound temperature and humidity, and promote healing. While 3M liquid dressing offers benefits and is widely used in IAD management, individualized assessment is necessary to determine its suitability for each patient.

In critically ill patients, IAD frequently develops due to frailty and prolonged bedrest. The condition arises from prolonged contact of urine or feces with the skin, leading to irritation, injury, and increased susceptibility to infection, most commonly affecting the perineum and buttocks.[22–24] Hydrocolloid dressings, composed of hydrophilic granules embedded in a hydrophobic polymer matrix, are designed for the management of wounds and burns and provide an airtight, moist, and slightly acidic environment optimal for healing. These properties help alleviate pain, maintain moisture, promote tissue repair, and prevent infection.[25,26] In patients with IAD, hydrocolloid dressings reduce discomfort and create a favorable environment for skin recovery. Previous studies have reported the widespread use of hydrocolloid dressings for rapid IAD healing in critically ill patients, with favorable outcomes.[27,28] In the present study, hydrocolloid dressings were observed to maintain wound moisture, prevent bacterial infection, and reduce injury to surrounding tissues caused by irritants. Additionally, the dressings form a transparent protective barrier that isolates the wound from external contaminants, thereby supporting tissue regeneration and reducing the risk of further microbial invasion.

The superior efficacy of hydrocolloid dressings compared with 3M liquid dressings in promoting rapid healing of IAD in critically ill patients may be attributed to their ability to maintain a consistently moist wound environment, which facilitates tissue repair. In contrast, 3M liquid dressings may not provide an adequate level of moisture. Furthermore, hydrocolloid dressings possess strong absorptive capacity, effectively managing wound exudates and secretions while reducing bacterial load on the skin surface. Their flexible nature allows them to conform to the contours of the skin, minimizing friction and the risk of tearing during patient movement.[29] These characteristics contribute to improved patient comfort, enhanced moisture retention, and efficient absorption, supporting faster and more effective healing in critically ill patients with IAD.

The SCORAD index, a tool for assessing the severity of eczema, evaluates multiple aspects of the disease, including lesion extent, pruritus, and sleep quality. Findings from this study indicate that hydrocolloid dressing therapy accelerated the healing process of IAD and alleviated symptoms, demonstrating significantly greater efficacy than 3M liquid dressing. Hydrocolloid dressings maintain a moist wound environment, promote tissue repair, and reduce the risk of infection, particularly in patients with incontinence whose skin is chronically exposed to urine and prone to inflammation. Previous studies have reported that hydrocolloid dressings reduce discomfort caused by urine-induced irritation and friction, while facilitating cell regeneration and tissue repair.[30] Clinical data further indicate that hydrocolloid dressings enhance patient comfort and shorten wound healing time by maintaining a clean and protected wound environment.[31] Collectively, these findings support the use of hydrocolloid dressings to accelerate wound

healing, reduce discomfort, and decrease the frequency of dressing changes, thereby improving quality of life in critically ill patients with IAD.

Hydrocolloid dressing treatment for IAD primarily alleviates symptoms by maintaining a moist local environment and preventing bacterial infection. As a transparent gel containing substantial moisture and active components, hydrocolloid dressings form a protective barrier that promotes wound healing. For perineal skin, these dressings provide additional hydration to lesions, support restoration of the normal skin barrier, and stimulate cellular regeneration, thereby reducing redness, ulceration, and other tissue injuries. Results from this study indicate that hydrocolloid dressing application also decreased patient-reported pain, likely by mitigating skin inflammation and pruritus, which further supports healing. Collectively, these findings demonstrate that hydrocolloid dressings can effectively treat IAD and significantly shorten the time required for lesion recovery. In addition to dressing application, regular diaper changes and maintenance of skin cleanliness and dryness remain essential nursing interventions to minimize local cellular injury and prevent chronic irritation-induced redness and swelling.

Although numerous studies have examined IAD,[32,33] research focusing specifically on IAD management in critically ill patients remains scarce, particularly regarding skin changes resulting from severe illness and intensive therapeutic interventions.[4,34] Existing evidence establishes alginate-hydrocolloid dressings as one of the most effective skin protectants for IAD;[35] however, gaps persist between best evidence and actual clinical nursing practice, largely due to limited nursing skills and insufficient preparedness for evidence-based practice. Prior studies have primarily compared different skin protectants or explored combination therapies, such as hydrocolloid dressings with ostomy powder, hydrocolloid versus zinc oxide ointment, hydrocolloid plus ostomy powder in patients with severe traumatic brain injury,[36] or Kangfuxin solution combined with hydrocolloid dressings in infants.[37] Other work has examined dressing combinations, such as hydrocolloid with transparent film or foam dressings with transparent film, for IAD prevention in ICU settings,[38] or compared hydrocolloid protection with regimens involving ostomy powder and skin barrier films in oncology patients with moderate to severe IAD.[39] However, none of these studies have targeted the unique challenges of IAD care in critically ill populations, where healing rates, time to recovery, frequency of dressing changes, and nursing workload are particularly consequential. Our study addresses this critical gap by evaluating an intervention tailored to the needs of severely ill patients, thereby contributing new evidence that supports more effective and feasible clinical management strategies for IAD in intensive care settings.

This study has several limitations. First, it was conducted at a single center with a relatively small sample size, which may have introduced selection bias. Second, although personnel responsible for implementing interventions and assessing outcomes were trained, complete blinding was not achieved, potentially resulting in implementation and measurement bias. Future research should include multicenter, large-sample randomized controlled trials with blinded outcome assessment to further validate these findings. Additionally, future studies could explore dressing selection strategies based on IAD staging to enable precise and individualized treatment approaches.

In summary, compared with liquid dressings, hydrocolloid dressings can accelerate healing of IAD in critically ill patients and improve overall treatment efficacy. However, the higher risk of complications associated with hydrocolloid dressings indicates the need for strict adherence to replacement protocols and enhanced skin monitoring during clinical use. Clinical decision-making should comprehensively consider IAD severity, exudate volume, and individual patient conditions to select the most appropriate barrier protection product.

Data Sharing Statement

All data generated or analysed during this study are included in this article. Further enquiries can be directed to the corresponding author.

Ethics Approval and Consent to Participate

This study was conducted with approval from Biomedical Ethics Committee of Peking University International Hospital (No.2022-KY-0061-02). This study was conducted in accordance with the declaration of Helsinki. Written informed consent was obtained from all participants.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare no competing interests.

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