OPEN

Management of Moisture-Associated Skin Damage: A Scoping Review

Kevin Y. Woo, PhD, NP; Dimitri Beeckman, PhD, RN; and Debashish Chakravarthy, PhD

ABSTRACT

BACKGROUND: Protecting the skin against moisture-associated damage is an important component of comprehensive skin and wound care. Based on a review of literature, the authors propose key interventions to protect and prevent damage in the skin folds, perineum, and areas surrounding a wound or stoma.

OBJECTIVE: The aim of this scoping review is to identify and provide a narrative integration of the existing evidence related to the management and prevention of moisture-associated skin damage (MASD).

METHODS: Study authors searched several databases for a broad spectrum of published and unpublished studies in English, published between 2000 and July 2015. Selected study information was collated in several different formats; ultimately, key findings were aggregated into a thematic description of the evidence to help generate a set of summative statements or recommendations.

RESULTS: Based on inclusion criteria, 37 articles were considered appropriate for this review. Findings included functional definitions and prevalence rates of the 4 types of MASD, assessment scales for each, and 7 evidence-based strategies for the management of MASD.

CONCLUSIONS: Based on this scoping review of literature, the authors propose key interventions to protect and prevent MASD including the use of barrier ointments, liquid polymers, and cyanoacrylates to create a protective layer that simultaneously maintains hydration levels while blocking external moisture and irritants.

KEYWORDS: moisture-associated skin damage, skin damage, incontinence-associated dermatitis, irritant contact dermatitis, scoping review, intertriginous dermatitis

ADV SKIN WOUND CARE 2017;30:494–501

INTRODUCTION

Among many vital functions, the skin functions as a barrier to protect the body against mechanical trauma, noxious irritants, infectious pathogens, and excessive fluids. Overexposure of the skin to moisture can compromise the integrity of the barrier, disrupting the intricate molecular arrangement of intercellular lipids in the stratum corneum and the intercellular connections between epidermal cells (corneocytes). Once damaged, the skin is more permeable and susceptible to irritant penetration, leading to inflammation or dermatitis. Further, wet skin has a high coefficient of friction, making it susceptible to friction and shear damage.

The term *moisture-associated skin damage* (MASD) delineates a spectrum of injury characterized by the inflammation and erosion (or denudation) of the epidermis resulting from prolonged exposure to various sources of moisture and potential irritants (eg, urine, stool, perspiration, wound exudate, and ostomy effluent).[1] Technically, MASD is a type of irritant contact dermatitis, but it is an umbrella term that includes 4 distinct clinical entities: incontinence-associated dermatitis (IAD), intertriginous dermatitis (ITD), periwound skin damage, and peristomal MASD.[1]

Moisture-associated skin damage is a complex, heterogeneous condition. With the shift in demographic toward an aging population worldwide, MASD is an increasingly common condition that places a significant burden on patients and the health system.[1] Patients with MASD experience intense, persistent symptoms such as pain, burning, and pruritus, especially where skin breakdown involves partial-thickness erosions and denudement. Emerging evidence highlights the association between MASD and other skin conditions such as dermatitis, cutaneous fungal/bacterial infection, and pressure injuries.[2,3]

The development and severity of MASD depend on a number of intrinsic and extrinsic factors. It is common among individuals with excessive perspiration, increased dermal metabolism (ie, elevated local temperature), abnormal skin pH, history of atopy (ie, genetic susceptibility to contaminants/irritants), deep body folds, dermal atrophy, and inadequate sebum production.[1,4] Extrinsic factors that may precipitate and exacerbate MASD are chemical/biologic irritants, mechanical stress on the skin (eg, friction, pressure, shear), fungal/candidiasis proliferation, seasonal or environmental factors (eg, humidity), incontinence (urine, fecal, or both), and hygienic practices.[4]

Prevention and treatment of MASD may encompass a variety of options including specialized equipment or surfaces, incontinence products, customized linen and fabrics, dressings, and skin

Kevin Y. Woo, PhD, NP, is Assistant Professor, Queen's University, Kingston, Ontario, Canada. Dimitri Beeckman, PhD, RN, is Professor, University Centre for Nursing and Midwifery, Ghent University, Ghent, Belgium. Debashish Chakravarthy, PhD, is Vice President, Medline Industries, Inc, Northfield, Illinois. The authors have disclosed that they have no financial relationships related to this article. Submitted December 15, 2016; accepted in revised form March 27, 2017.

cleansing agents, in addition to topical application of barriers and moisturizers to protect or strengthen the skin. It is important to implement cost-effective evidence-based practices to prevent and treat MASD; therefore, this article presents a scoping review of management strategies and interventions for preventing or treating MASD across the continuum of care.

Aim

The aim of this scoping review is to identify and provide a narrative integration of the existing evidence related to the management and prevention of MASD. A scoping review is a form of knowledge synthesis used to map key concepts, types of evidence, and gaps in research to inform policy makers, practitioners, and patients.

METHODS

This scoping review follows the methodology proposed by Arksey and O'Malley[5] to help map, review, and synthesize a wide range of existing evidence. Unlike systematic reviews, a scoping review does not involve detailed critical appraisal of individual studies.

Inclusion Criteria

This review included a broad spectrum of published and unpublished studies encompassing meta-analysis, randomized controlled trials (RCTs), case-control studies, case series, and case studies that evaluated interventions to prevent or manage MASD and related conditions in any setting, on any clinical population, of any age. Only studies published in English were considered. Opinion papers, commentaries, and editorials were excluded from this scoping review to minimize bias. Studies published from 2000 to July 2015 were considered for inclusion.

An initial search of MEDLINE and CINAHL was undertaken by the authors followed by an analysis of titles and abstracts and of the index terms used to describe each article. With the help of a science librarian, a second search using all identified keywords and index terms was undertaken across several databases: the Cochrane Database of Systematic Reviews, the Joanna Briggs Institute, the Effective Practice and Organization of Care database, CINAHL, MEDLINE, EMBASE, and the Health Technology Assessment database. Search strategies involved using the following keywords: moisture, skin damage, exudate, intertrigo, ITD, IAD, MASD, and periwound, ostomy, and stoma. The reference lists of all identified articles were searched for additional studies to include.

Study Selection

Two reviewers independently reviewed each title and abstract of the literature search results to determine whether the article should receive a more in-depth review. Reviewers were instructed to include articles even when there was insufficient information to determine the relevance. When disagreements on study inclusion emerged, discrepancies were resolved through discussion.

Collating, Summarizing, and Reporting the Results

Relevant information was extracted from selected articles using a standardized abstraction form to document author names, the purpose of the study/paper, types of participants, research methods, study setting, outcome and assessment details, conclusions, and implications for practice.

The number of studies and their characteristics—including study design, year of publication, type(s) of interventions, study population, and key findings—are summarized in Supplemental Digital Content 1, http://links.lww.com/NSW/A9.

A summary of key findings and proposed recommendations also were compiled into a topic matrix to allow easy comparison by topic and strength of evidence.

In the final synthesis of this scoping review, key findings were aggregated into a thematic description of the evidence to help generate a set of summative statements or recommendations.

RESULTS

The initial literature search yielded 283 articles. Based on the inclusion criteria, 37 articles were considered appropriate for the review.[2,6–41] Of all the selected articles, 15 studies evaluated the management/prevention of IAD, 15 studies addressed periwound skin damage, 2 studies addressed peristomal MASD, and 5 were miscellaneous studies. Various study designs were included: 15 RCTs, 12 quasi-experimental studies, 6 prospective observational studies, 3 case studies, and 1 meta-analysis.

Together, the findings from these articles provided functional definitions and prevalence rates of the 4 types of MASD, assessment scales for each, and 7 evidence-based strategies for the management of MASD.

Defining MASD

1. Incontinence-Associated Dermatitis

The ammonia in urine and/or stool creates an alkaline environment that potentiates the proteolytic activity of fecal enzymes (protease and lipase) on skin, leading to IAD. These enzymes disrupt the skin acid mantle, making it easy for irritants to penetrate into the skin and trigger an inflammatory response. Current estimates of IAD prevalence ranges from 5.6% to 50% across different healthcare settings, patient populations, and age groups; it is highest among critically ill patients.[42]

Growing attention is being paid to the relationship between IAD and pressure injury development. A study using the Minimum Data Set showed that individuals with frequent bowel continence (odds ratio, 4.15; 95% confidence interval [CI], 4.07–4.23) were 4.15 times more likely to develop pressure ulcers (95% CI,

4.07–4.23).[43] In a recent systematic review and meta-analysis, Beeckman et al[44] confirmed that individuals with bowel and bladder incontinence and related IAD are 4.99 times more likely (95% CI, 2.62–9.50) to develop pressure ulcers than those who are continent.

2. Intertriginous Dermatitis

Also called intertrigo, ITD is a type of moisture-related skin damage between skin folds, commonly found in the inframammary, pannus, groin, perianal, and interdigital areas. The combination of excess moisture from perspiration, occlusion with limited air flow, and friction between the opposing epidermal surfaces can lead to ITD.[45,46] Intertriginous dermatitis is initially characterized by mirror-image erythema, inflammation, and peripheral scaling, but over time the epidermis can become macerated, edematous, crusted, and eroded and provide an optimal environment for the proliferation of microorganisms such as *Candida albicans* that can cause secondary infections.[45–47]

Based on current understanding of the pathophysiology that underlies ITD, a number of risk factors have been considered including hyperhidrosis, immunodeficiency, diabetes mellitus, immobility, large skin folds, and obesity.[45–47] The prevalence of ITD varies by context: 6% in acute care, 17% in long-term care, and 20% in community dwellings.[48]

3. Periwound Skin Damage

While moisture is essential to promote wound healing, wound fluid contains endogenous protein-degrading enzymes that are caustic and damaging to the intact skin.[49,50] Periwound skin is particularly vulnerable to MASD when drainage volume exceeds the fluid-handling capacity of a dressing. In addition, repetitive application and removal of adhesive tapes and dressings may strip away the periwound stratum corneum, precipitating further skin damage.

Periwound skin damage is not well documented, and the exact prevalence of periwound skin damage remains elusive. Nevertheless, the impact of periwound skin damage is substantial. One large-scale international survey involving 2018 patients with chronic wounds found that 25% of respondents experienced pain around the wound, likely from periwound skin damage and local inflammatory responses.[51] Woo et al[2] also identified that increased periwound maceration, a vestige of skin damage from excess moisture, is correlated with higher pain levels prior to and during foam dressing changes. It is also acknowledged in the literature that periwound skin damage may affect keratinocyte migration from wound edges to the wound base, delaying overall wound healing.[52,66]

4. Peristomal Moisture-Associated Skin Damage

Peristomal MASD is characterized by inflammation and erosion of the mucocutaneous junction and surrounding area.[52,53] Despite various containment strategies, fecal effluent may leak and spill over to the peristomal skin, particularly in patients with hyperactive bowels, diarrhea, and fistulas that connect the bowel and skin surface. Undulating contour of the abdomen from excessive subcutaneous fat, poor muscle tone, herniation, fissures (a linear break in the skin with a dermal base), or crevices linked to skin/muscle defects present challenges that often lead to poor appliance adherence and pouch leakage.

Establishing a secure pouching system postmaceration is the primary complication associated with peristomal MASD, because it perpetuates a vicious cycle: Eroded epidermis produces moisture that impedes the pouching system from adhering to the skin and forming a tight seal, leading to further effluent-skin contact that in turn causes greater maceration and pouching difficulties.[5,52,54,55] More than 50% of individuals with ostomies may experience leakage, and the probability of developing peristomal MASD over the life course for colostomates and ileostomates is approximately 17.4% and 34%, respectively.[56,57]

The skin around a percutaneous endoscopic gastrostomy is also at risk of MASD because of potential leakage of both digestive enzymes (eg, bile salts, pancreatic lipases) and nutritional formula.[58] For patients with tracheostomy, perspiration, saliva, or sputum can accumulate around the stoma, under the flange of the external cannula, and on the tracheostomy tie. Skin damage can be precipitated by inappropriate tube size/circumference and tracheostomy dressing and change frequency.[59,60] Unfortunately, none of the studies examined the prevalence of skin damage in the tracheostomy or gastrostomy areas.

Assessment of MASD

Incontinence-associated dermatitis typically presents as diffuse erythema but may also be characterized by erosion, edema, scaling, papules, or bullae containing serous exudate with accompanying pruritus, burning, or pain.[7,61] The Incontinence Associated Dermatitis and Its Severity instrument is a novel tool that assesses for redness, skin loss, and rash in the 13 body locations affected by IAD. A score of 0 to 52 is generated and used to inform practice.[62] Further, the Incontinence-Associated Dermatitis Skin Condition Assessment Tool was developed by Beeckman et al[7] to describe the surface area (in centimeters squared), severity of redness, and depth of any perineal skin lesion.

More recently, a Global IAD Categorization tool was developed by an international expert panel and psychometrically tested by 823 health professionals from 30 countries.[63] The tool is simple to use. First, the damaged skin is assessed to determine whether persistent redness or skin loss is present. Next, clinical infection or intertrigo is evaluated based on a cluster of signs and symptoms. As such, the IAD is classified into 4 categories: persistent redness without clinical signs of infection, persistent redness

with clinical signs of infection, skin loss without clinical signs of infection, and persistent redness with clinical signs of infection.

While ITD and IAD are precipitated by similar factors, ITD affects other areas that are not affected by incontinence. Areas affected by ITD can appear erythematous with scaling. Secondary candida intertrigo is plausible based on the characteristic appearance of satellite lesions. However, a validated measurement scale to describe the severity of ITD is not available.

Periwound skin damage is evident from the varying degree of skin maceration, erythema, edema, inflammation, blistering, excoriation, and erosion. White maceration is when the skin appears white and swollen, and erythematous maceration is when the skin is reddened and inflamed. Characteristic manifestations of periwound skin damage include erosion, erythema, edema, bleb formation, pruritus, edema, and pain.[65] There are no standardized tools to measure or assess periwound skin damage.

Peristomal MASD is inflammation and erosion of the skin related to moisture that begins at the stoma/skin junction and may extend outward.[52] The Ostomy Skin Tool is designed to assess the peristomal skin in 2 ways. First, it determines a score based on discoloration, erosion, and tissue overgrowth. Pictorial references are provided to aid the assessor. Second, the Ostomy Skin Tool provides a diagnostic guide that directs the caregiver through an interview with the patient to determine possible causes of the skin disorder (eg, chemical irritation, mechanical irritation, or infection).[64]

Management of MASD

1. Wash vulnerable skin with a gentle cleanser with minimal rubbing. Avoid the use of soaps with an alkaline pH.

There is an increased bacterial count in the periwound skin compared with normal skin.[65] Mechanical cleansing of periwound skin can reduce the number of microorganisms not only on the skin but also in the wound bed. The pH of healthy skin is approximately 5 to 5.5, so when choosing a cleansing agent, it is prudent to avoid alkaline products that can alter the pH of the skin surface to a more basic environment promoting bacterial growth.[66] Surfactant-based cleanser may be considered to help remove skin debris such as water-insoluble proteins and lipids.

2. Use absorbent dressings for highly exudative wounds and match dressing changes to exudate levels.

The importance of selecting an appropriate wound dressing for protection against MASD is 2-fold: to support healing and prevent further damage. An ideal dressing creates an optimal moisture balance by maintaining wound hydration while also keeping damaging exudate away from the wound and periwound surface. This balance requires a skillful and thoughtful selection of the right dressing and frequency of changes.

Dressings are categorized according to their forms and functions, especially in terms of absorbency and fluid-handling capacity. Materials such as alginate, hydrofiber, polymers, and foam are designed to handle large volume of fluid. The fluid-handling capacity of various dressings may also be affected by the polyurethane film backing and its ability to transfer moisture vapor out of the dressing. Dressings may differ in their capacity to lock in wound fluid, especially when pressure is applied, such as with compression wraps.

It is ideal for a dressing to optimize vertical wicking (movement of fluid into the dressing) while minimizing the risk of lateral movement of fluid to periwound skin.[67] If lateral wicking is anticipated, the interface area where the dressing is appended to the skin should be kept to a minimum by cutting the dressing down to the size of the wound opening or selecting an appropriate dressing size.

3. Use atraumatic tapes or adhesives.

Repeated application and removal of adhesive tapes and appliances pull the skin surface from the epithelial cells, and this can precipitate skin damage by stripping away the stratum corneum.[2] In severe cases, erythema, edema, and blistering have been observed. The periwound breakdown of surface keratin results in local maceration and hyperhydration of the underlying epidermal cells and dermal components.

As an alternative, dressings with silicone are superior in preventing trauma. However, the silicone interface may create a physical barrier that slows down fluid absorption, exposing the skin to prolonged moisture. Take caution with patients who are incontinent to avoid keeping soiled or saturated dressings in direct contact with the skin.

4. Apply a barrier to vulnerable skin.

A plethora of treatments can protect the periwound skin, including cyanoacrylate formulations, petrolatum- or silicone-based barrier ointments, and polymer films that form on application through solvent evaporation. These are available in squeezable tubes, sprays, wipes, and/or vials.

The advantages and disadvantages of various skin barriers are summarized in Table 1. Despite efficacy in protecting the periwound tissue, variations in barrier formulation can affect secondary factors such as patient pain and sensitization. There is no evidence that one barrier/protectant in the market is better than any other; the performance of each product depends on the overall formulation and frequency of application, rather than on the principal ingredient. However, Gray and Weir[68] rank various techniques for prevention of periwound maceration by the strength of supporting evidence. Skin protectants such as solvent-based polymer film barriers and zinc oxide–thickened mechanical ointments are the only products to receive a score of 1, indicating the highest level of supporting evidence.

Table 1.

CLINICAL BARRIER OPTIONS FOR PROTECTION AGAINST MOISTURE-ASSOCIATED SKIN DAMAGE

Product Category	Advantages	Disadvantages
Petrolatum-based barrier ointments (a soft paraffin or wax mixture)	• Forms a seal over the skin to reduce transepidermal water loss; optimal effect when applied to slightly dampened skin • Thickening properties to protect against mechanical damage and serve as a physical barrier against irritants	• Petrolatum may melt under heat • May eave a greasy residue that interferes with primary dressing adherence and absorption • May build up in the pores and attract dirt and bacteria, increasing the risk of folliculitis
Zinc oxide–thickened petrolatum-containing barrier ointments	• Repels irritants in exudate, urine, and other fluids • Thickening properties to protect against mechanical damage • Anti-inflammatory and antioxidant	• Preparations may be thick and difficult to apply and remove • May interfere with primary dressing adherence and absorption • Ointment may inadvertently get into the wound and interfere with antimicrobial ingredients
Silicone-based barrier ointments (such as dimethicone)	• Dimethicone is permeable to water vapor that allows evaporation of perspiration and minimizes the risk of miliaria (heat rash) • Conformable to periwound area or area of at risk skin • Easy to spread and feels less greasy on skin	• Thick ointments may interfere with primary dressing adherence and absorption • Ointment may inadvertently get into the wound and may not be indicated for use in open wounds
Film-forming polymers in water or organic solvents	• Forms a mechanical barrier over periwound surface • Thin and nonmessy • Allows for adherence of wound dressing and protects against skin stripping during dressing changes	• Certain organic solvents may cause stinging and irritation; also obvious inhalation and fire hazards • Much of the applied liquid evaporates, leaving a very thin, insubstantial film compared with cyanoacrylates
Cyanoacrylate formulations	• Creates a moisture-resistant barrier on skin • Protects against friction-induced skin damage • Does not require solvent, so all of the applied liquid turns into a barrier • Bonds to skin via polymerization in situ so very resistant to wash off or premature removal	• Cyanoacrylates are somewhat expensive raw materials in skin barrier formulations • Individuals may be allergic to cyanoacrylates

Petrolatum-based barrier ointments are popular for the prevention and management of MASD. Petrolatum is a semisolid mixture of hydrocarbons that are hydrophobic (water repelling). It tends to melt at a temperature of 37° C (99° F), close to normal human body temperature. Intended to be a lubricant, petrolatum can leave a greasy residue that prevents adhesives and dressings from staying on periwound skin.

A zinc oxide–based barrier is another option. Zinc oxide is an inorganic compound found in a variety of topical agents such as powder, calamine cream, sunscreen, and shampoo. Zinc oxide–based barriers coat and shield the skin from moisture and irritants. It is not necessary to remove the barrier unless the material is soiled; vigorous cleansing and rubbing can damage the fragile and damaged skin. Depending on the formulation, metal oxide preparations may also interfere with dressing absorption and adhesion.

Silicone-based barrier products have also been shown to be effective in the protection and management of periwound skin.[29,51] Silicone consists of chains of hydrophobic polymers with alternating molecules of silicone and oxygen. Recent formulations with silicone may include micronutrients and antioxidants, which seem to benefit skin health based on the ability of such products to prevent skin tears and reduce pressure ulceration.

Polymer film barrier preparations. Organic solvent- or water-based formulations that contain polymers can form barrier films after application upon evaporation of the solvent.[66] These polymer barrier preparations, like petrolatum- and silicone-based ointments, are well supported for prevention of maceration in the periwound region.[42,52,69–71]

Be careful when using polymer film barriers containing gum mastic, a natural resin from the *Pistacia lentiscus* tree. There have been reports of allergic skin reactions and irritant contact dermatitis following application of barrier products containing it. These adverse reactions to gum mastic have occurred when product was applied after surgery, during patch testing, and to secure catheters.[72–76]

Alcohol was used as a solvent in many early formulations of barrier films, and the introduction of no-sting alcohol-free preparations has significantly reduced patient pain upon product application.[24,35,38,77] The no-sting preparations retain their efficacy; in a study of 33 rehabilitation unit patients, maceration was prevented in 94% of subjects, and skin stripping was absent in all 33 subjects.[77] In a double-blind study of 227 venous stasis ulcer patients, a no-sting barrier film and water control were applied to opposing edges of the wound in each patient. In 97.3%

of subjects, application of the barrier product controlled or reduced erythema as measured via a chromameter.[78]

Within the polymer film barriers, there is evidence suggesting that organic solvent-free formulations provide greater protection against skin trauma than equivalent solvent-containing formulations.[38] An RCT comparing 2 formulations, 1 with an organic solvent base and 1 solvent-free formulation, was conducted on 12 human subjects. Adhesive tape was applied to skin sections treated with no product, solvent-free product, or solvent-containing product. Stripping of the tape from the skin once a day over 5 days was used to simulate skin trauma inflicted by dressing adhesives in a clinical setting. Outcomes measured were site erythema and transepidermal water loss (an established parameter of skin microclimate and representative of the barrier properties of the skin).[79,80] Erythema, as evaluated by both an independent grader and by a chromameter, was significantly reduced on skin treated with the solvent-free barrier from day 4 onward. Water loss was also reduced for skin treated with the solvent-free polymer. For all 3 measures, the solvent-containing formulation provided no more protection than no treatment at all, and the disparity between the 2 formulations increased with repeated tape stripping.[38]

Cyanoacrylates. A special class of acrylate polymer derivatives has become available in recent years. These materials are known generically as cyanoacrylates, or in common parlance, "superglue." Cyanoacrylates, or more accurately alkyl esters of cyanoacrylates, are compounds that have an extra cyano group attached to the acrylate portion of a molecule. This addition of the cyano(-CN) chemical group to the acrylate moiety in the film-forming monomer renders these compounds very sensitive to moisture on skin, resulting in the formation of a flexible yet tough film very quickly, within seconds, on the skin. The film that forms on skin after application is a polymeric form of the monomeric cyanoacrylate that remains a liquid until it is delivered to skin via an ampoule. Upon application, the monomeric liquid begins rapid polymerization. The liquid is provided without solvents, which eliminates the problems generally associated with organic solvents such as inhalation hazards and fire risks. In addition, this class of materials bonds chemically to the skin surface as opposed to being deposited as a polymer film.

Cyanoacrylates seem to have a unique degree of robustness, based on experience from clinicians who have written on the skin protective aspect of these materials.[22,39] A case series by Milne et al,[22] for example, has discussed the successful use of a cyanoacrylate protectant in the skin management of peristomal irritant dermatitis and superficial skin lesions in residents in acute care and outpatient settings. The cyanoacrylate protectant is supplied in unit-dose ampoules and has a purple tint that allows clinicians to identify the area where the liquid barrier is applied to avoid excessive application. The barrier is shed naturally from the skin surface as the stratum corneum sloughs off, and this sloughing off is easily monitored by the gradual fading of the purple tint. Experience shows that once bonded to skin, exposure to body fluids or washing or soaping with water will not eliminate the product from skin for 24 to 72 hours, which demonstrates the ability of the chemical bond of the cyanoacrylate product to the underlying skin to resist external insult from environmental agents.[40] The concentration of the cyanoacrylate could matter, because cyanoacrylates that are formulated with diluting solvents will tend to produce a thinner and less robust protective film.

5. Treat skin infection and dermatitis.

Patients with chronic wounds are exposed to a plethora of potential contact irritants and allergens, leading to dermatitis. The best approach to dermatitis is to treat the trigger or cause, address secondary infection, and then use topical steroids for the inflammatory component. Although moisture-wicking fabric may be useful for the management of moisture in skin folds, the effectiveness for the prevention and treatment of ITD remains unclear.

6. Regularly assess skin around wounds and areas that are susceptible to moisture damage.

Although there are a number of tools that have been developed to describe wound status, none of the tools address periwound skin condition. The Bates-Jensen Wound Status Tool instructs clinicians to document wound edges and skin surrounding the wound in terms of discoloration. To provide a comprehensive assessment of periwound skin, it is recommended that the skin is evaluated and assessed for maceration, erythema, and erosion related to MASD.

7. Promote optimal skin health.

The stratum corneum normally has 10% to 15% moisture content. While excessive moisture is damaging, dry skin is prone to superficial breaks leading to scaling, flaking, and fissuring, allowing irritants to penetrate into deep skin structures. In severe cases, xerotic areas are characterized by intense irritation, inflammation, and itchiness. Natural moisturizing factors are found in the stratum corneum. They are humectants that can rehydrate skin because of their hydroscopic property to attract and bind water molecules from the atmosphere, donating it into the corneocytes. Replenishing natural moisturizing factors and humectants can be accomplished through the application of moisturizers containing amino acids such as pyrrolidone carboxylic acid, urocanic acid, propylene glycol (glycerine), lactic acid, and urea. Other ingredients that should be considered to promote healthy skin are ceramides (the major lipid constituent in the intercellular spaces of the stratum corneum), essential fatty acids such as linoleic acid that may modulate inflammatory and immune responses in the skin, vitamins, and antioxidants to combat against damaging effects of reactive oxygen species radicals.

CONCLUSIONS

Moisture can induce significant damage in the skin folds, perineum, and areas surrounding a wound or stoma comprising the skin's normal function as a barrier. Protection of the skin against moisture damage is an important component of comprehensive skin and wound care. Based on this scoping review of literature, the authors propose key interventions to protect and prevent MASD including the use of barrier ointments, liquid polymers, and cyanoacrylates, which can be applied on the periwound region to create a protective layer that simultaneously maintains hydration levels while blocking external sources of moisture and irritants. There is a need for additional studies to validate existing and emerging technologies for the management of MASD in various clinical settings and patient populations. ●

REFERENCES

1. Gray M, Black JM, Baharestani MM, et al. Moisture-associated skin damage: overview and pathophysiology. J Wound Ostomy Continence Nurse 2011;38(3):233-41.
2. Woo KY, Coutts PM, Price P, Harding K, Sibbald RG. A randomized crossover investigation of pain at dressing change comparing 2 foam dressings. Adv Skin Wound Care 2009;22:304-10.
3. Jones JE, Robinson J, Barr W, Carlisle C. Impact of exudate and odour from chronic venous leg ulceration. Nurs Stand 2008;22(45):53-4, 56, 58 passim.
4. Bianchi J. Causes and strategies for moisture lesions. Nurs Times 2012;108(5):20-2.
5. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. Int J Soc Res Methodol 2005;8:19-32.
6. Baatenburg de Jong H, Admiraal H. Comparing cost per use of 3M Cavilon No Sting Barrier Film with zinc oxide oil in incontinent patients. J Wound Care 2004;13(9):398-400.
7. Beeckman D, Verhaeghe S, Defloor T, Schoonhoven L, Vanderwee K. A 3-in-1 perineal care washcloth impregnated with dimethicone 3% versus water and pH neutral soap to prevent and treat incontinence-associated dermatitis: a randomized, controlled clinical trial. J Wound Ostomy Continence Nurs 2011;83(6):627-34.
8. Beguin AM, Malaquin-Pavan E, Guihaire C, et al. Improving diaper design to address incontinence associated dermatitis. BMC Geriatr 2010;10:86.
9. Brunner M, Droegemueller C, Rivers S, Deuser WE. Prevention of incontinence-related skin breakdown for acute and critical care patients: comparison of two products. Urol Nurs 2012;32(4):214-9.
10. Clever K, Smith G, Bowser C, Monroe K. Evaluating the efficacy of a uniquely delivered skin protectant and its effect on the formation of sacral/buttock pressure ulcers. Ostomy Wound Manage 2002;48(12):60-7.
11. Cooper P, Gray D. Comparison of two skin care regimes for incontinence. Br J Nurs 2001; 10(6 Suppl):S6, S8, S10 passim.
12. Cooper P, Gray D, Ressell F. Comparing Tena Wash Mousse with Clinisan Foam Cleanser: the results of a comparative study. Wounds UK 2008;4(3):12-21.
13. Fader M, Clarke-O'Neill S, Cook D, et al. Management of night-time urinary incontinence in residential settings for older people: an investigation into the effects of different pad changing regimes on skin health. J Clin Nurs 2003;12(3):374-86.
14. Kerr A, Arrowsmith M, Young S, Jaimes H. Evaluation of a skin barrier cream for managing IAD in elderly patients using high-frequency ultrasound. Br J Community Nurs 2014;19(12): 585-91.
15. Lewis-Byers K, Thayer D. An evaluation of two incontinence skin care protocols in a long-term care setting. Ostomy Wound Manage 2002;48(12):44-51.
16. Palese A, Carniel G. The effects of a multi-intervention incontinence care program on clinical, economic, and environmental outcomes. J Wound Ostomy Continence Nurs 2011; 38(2):177-83.
17. Park KH. The effect of a silicone border foam dressing for prevention of pressure ulcers and incontinence-associated dermatitis in intensive care unit patients. J Wound Ostomy Continence Nurs 2014;41(5):424-9.
18. Park KH, Kim KS. Effect of a structured skin care regimen on patients with fecal incontinence: a comparison cohort study. J Wound Ostomy Continence Nurs 2014;41(2):161-7.
19. Sugama J, Sanada H, Shigeta Y, Nakagami G, Konya C. Efficacy of an improved absorbent pad on incontinence-associated dermatitis in older women: cluster randomized controlled trial. BMC Geriatr 2012;12:22.
20. Zehrer CL, Newman DK, Grove GL, Lutz JB. Assessment of diaper-clogging potential of petrolatum moisture barriers. Ostomy Wound Manage 2005;51(12):54-8.
21. Hosseinpour M, Fazeli A, Agabeigi M. Efficacy of Acacia senegal for stoma care in children with colostomy. Eur J Pediatr Surg 2012;22(3):234-7.
22. Milne CT, Saucier D, Trevellini C, Smith J. Evaluation of a cyanoacrylate dressing to manage peristomal skin alterations under ostomy skin barrier wafers. J Wound Ostomy Continence Nurs 2011;38(6):676-9.
23. Brown-Etris M, Punchello M, O'Connor T. Use of a transparent absorbent acrylic dressing on stage II and III pressure ulcers. J Wound Ostomy Continence Nurs 2006:S53-4.
24. Cameron J, Hoffman D, Wilson J, Cherry G. Comparison of two peri-wound skin protectants in venous leg ulcers: a randomised controlled trial. J Wound Care 2005;14(5):233-6.
25. Coutts P, Queen D, Sibbald RG. Peri-wound skin protection: a comparison of a new skin barrier vs. traditional therapies in wound management. Wound Care Canada. 2003;1(1):19. www.woundscanada.ca/docman/public/wound-care-canada-magazine/2003-vol-1-no-1/216-wcc-2003-vol1n1-peri-wound-skin-protection/file. Last accessed August 30, 2017.
26. Cutting KF. Managing wound exudate using a super-absorbent polymer dressing: a 53-patient clinical evaluation. J Wound Care 2009;18(5):200, 202-5.
27. Durante CM, Greco A, Sidoli O, Maino C, Gallarini A, Ciprandi G. Evaluation of the effectiveness of a polyhexanide and propyl betaine-based gel in the treatment of chronic wounds. Minerva Chir 2014;69(5):283-92.
28. Faucher N, Safar H, Baret M, Philippe A, Farid R. Superabsorbent dressings for copiously exuding wounds. Br J Nurs 2012;21(12):S22, S24, S26-8.
29. Hunter SM, Langemo D, Thompson P, et al. Observations of periwound skin protection in venous ulcers: a comparison of treatments. Adv Skin Wound Care 2013;26(2):62-6.
30. Jørgensen B, Price P, Andersen KE, et al. The silver-releasing foam dressing, Contreet Foam, promotes faster healing of critically colonised venous leg ulcers: a randomised, controlled trial. Int Wound J 2005;2(1):64-73.
31. Lázaro-Martínez JL, García-Morales EA, Aragón-Sánchez FJ, Año-Vidales P, Allas-Aguado S, García-Alvarez Y. [Reducing skin maceration in exudative diabetic foot ulcers]. Rev Enferm 2010;33(3):9-14.
32. Maume S, van de Looverbosch D, Heyman H, Romanelli M, Ciangherotti A, Charpin S. A study to compare a new self-adherent soft silicone dressing with a self-adherent polymer dressing in stage II pressure ulcers. Ostomy Wound Manage 2003;49(9):44-51.
33. Münter KC, Beele H, Russell L, et al. Effect of a sustained silver-releasing dressing on ulcers with delayed healing: the CONTOP study. J Wound Care 2006;15(5):199-206.
34. Reyzelman AM, Vayser D, Tam SW, Dove C. Initial clinical assessment of a novel wound management system: a case series. Adv Skin Wound Care 2011;24(6):256-60.
35. Schuren J, Becker A, Sibbald RG. A liquid film-forming acrylate for peri-wound protection: a systematic review and meta-analysis (3M Cavilon no-sting barrier film). Int Wound J 2005;2(3):230-8.
36. Vanscheidt W, Sibbald RG, Eager CA. Comparing a foam composite to a hydrocellular foam dressing in the management of venous leg ulcers: a controlled clinical study. Ostomy Wound Manage 2004;50(11):42-55.
37. Hoggarth A, Waring M, Alexander J, Greenwood A, Callaghan T. A controlled, three-part trial to investigate the barrier function and skin hydration properties of six skin protectants. Ostomy Wound Manage 2005;51(12):30-42.
38. Shannon RJ, Chakravarthy D. Effect of a water-based no-sting, protective barrier formulation and a solvent-containing similar formulation on skin protection from medical adhesive trauma. Int Wound J 2009;6(1):82-8.
39. Woo KY. Health economic benefits of cyanoacrylate skin protectants in the management of superficial skin lesions. Int Wound J 2014;11(4):431-7.
40. Woo KY, Chakravarthy D. A laboratory comparison between two liquid skin barrier products. Int Wound J 2014;11(5):561-6.
41. Young DL, Chakravarthy D. A controlled laboratory comparison of 4 topical skin creams moisturizing capability on human subjects. J Wound Ostomy Continence Nurs 2014;41(2):168-74.
42. Gray M, Bliss DZ, Doughty DB, Ermer-Seltun J, Kennedy-Evans KL, Palmer MH. Incontinence-associated dermatitis: a consensus. J Wound Ostomy Continence Nurs 2007;34(1):45-54; quiz 55-6.
43. Woo KY, Sears K, Almost J, Wilson R, Whitehead M, VanDenKerkhof EG. Exploration of pressure ulcer and related skin problems across the spectrum of health care settings in Ontario using administrative data. Int Wound J 2017;14(1):24-30.
44. Beeckman D, van Lancker A, van Hecke A, Vergaeghe S. A systematic review and meta-analysis of incontinence-associated dermatitis, incontinence, and moisture as risk factors for pressure ulcer development. Res Nurs Health 2014;37(3):204-18.

45. Black JM, Gray M, Bliss DZ, et al. MASD part 2: incontinence-associated dermatitis and intertriginous dermatitis: a consensus. J Wound Ostomy Continence Nurs 2011;38(4):359-70; quiz 371-2.
46. Sibbald RG, Kelley J, Kennedy-Evans KL, Labrecque C, Waters N. A practical approach to the prevention and management of intertrigo, or moisture-associated skin damage, due to perspiration: expert consensus on best practice. Wound Care Canada 2013;11(2):1-21.
47. Kalra MG, Higgins KE, Kinney BS. Intertrigo and secondary skin infections. Am Fam Physician 2014;89(7):569-73.
48. Mistiaen P, van Halm-Walters M. Prevention and treatment of intertrigo in large skin folds of adults: a systematic review. BMC Nurs 2010;9:12.
49. Nagase H, Visse R, Murphy G. Structure and function of matrix metalloproteinases and TIMPs. Cardiovasc Res 2006;69(3):562-73.
50. Ravanti L, Kahari VM. Matrix metalloproteinases in wound repair [review]. Int J Mol Med 2000;6(4):391-407.
51. Price PE, Fagervik-Morton H, Mudge EJ, et al. Dressing-related pain in patients with chronic wounds: an international patient perspective. Int Wound J 2008;5(2):159-71.
52. Colwell JC, Ratliff CR, Goldberg M, et al. MASD part 3: peristomal moisture-associated dermatitis and periwound moisture-associated dermatitis: a consensus. J Wound Ostomy Continence Nurs 2011;38(5):541-53; quiz 554-5.
53. Ratliff CR. Early peristomal skin complications reported by WOC nurses. J Wound Ostomy Continence Nurs 2010;37(5):505-10.
54. Stephen-Haynes J. The importance of peristomal skin care in the community setting. J Community Nurs 2013;27(4):73-4, 76-7.
55. Rudoni C. Peristomal skin irritation and the use of a silicone-based barrier film. Br J Nurs 2011;20(16):S12, S14, S16 passim.
56. Raitliff C, Scarano K, Donovan A, Colwell J. Descriptive study of peristomal complications. J Wound Ostomy Continence Nurs 2005;32(1):33-7.
57. McMullen CK, Wasserman J, Altschuler A, et al. Untreated peristomal skin complications among long-term colorectal cancer survivors with ostomies: lessons from a study of family caregiving. Clin J Oncol Nurs 2011;15(6):644-50.
58. Rahnemai-Azar AA, Rahnemaiazar AA, Naghshizadian R, Kurtz A, Farkas DT. Percutaneous endoscopic gastrostomy: indications, technique, complications and management. World J Gastroenterol 2014;20(24):7739-51.
59. Kwiatt M, Tarbox A, Seamon MJ, et al. Thoracostomy tubes: a comprehensive review of complications and related topics. Int J Crit Illn Inj Sci 2014;4(2):143-55.
60. Huffman B, Emam H, Stevens M. Tracheostomy with emphasis on perioperative nursing care. J Nurs Educ Pract 2014;4:13.
61. Zulkowski K. Diagnosing and treating moisture-associated skin damage. Adv Skin Wound Care 2012;25(5):231-6; quiz 237-8.
62. Borchert K, Bliss DZ, Savik K, Radosevich DM. The incontinence-associated dermatitis and its severity instrument: development and validation. J Wound Ostomy Continence Nurs 2010;37(5):527-35.
63. Beeckman D, van den Bussche K, Alves P, et al. The Ghent Global IAD Categorisation Tool (GLOBIAD). 2017. http://users.ugent.be/~dibeeckm/globiadnl/nlv1.0.pdf. Last accessed September 18, 2017.
64. Page AC. Two new tools for your ostomy practice. Ostomy Wound Manage 2009;55(12):10.
65. Konya C, Sanada H, Sugama J, et al. Skin debris and micro-organisms on the periwound skin of pressure ulcers and the influence of periwound cleansing on microbial flora. Ostomy Wound Manage 2005;51(1):50-9.
66. Woo KY, Sibbald RG. The ABCs of skin care for wound care clinicians: dermatitis and eczema. Adv Skin Wound Care 2009;22(5):230-6; quiz 237-8.
67. Okan D, Woo K, Ayello EA, Sibbald G. The role of moisture balance in wound healing. Adv Skin Wound Care 2007;20(1):39-53; quiz 53-5.
68. Gray M, Weir D. Prevention and treatment of moisture-associated skin damage (maceration) in the periwound skin. J Wound Ostomy Continence Nurs 2007;34(2):153-7.
69. Voegeli D. Moisture-associated skin damage: aetiology, prevention and treatment. Br J Nurs 2012;21(9):517-8, 520-1.
70. Fonder MA, Lazarus GS, Cowan DA, Aronson-Cook B, Kohli AR, Mamelak AJ. Treating the chronic wound: a practical approach to the care of nonhealing wounds and wound care dressings. J Am Acad Dermatol 2008;58(2):185-206.
71. Hollinworth H. Challenges in protecting peri-wound skin. Nurs Stand 2009;24(7):53-4, 56, 58 passim.
72. Kline A. Allergic contact dermatitis of the foot after use of Mastisol® skin adhesive: a case report. Foot Ankle J 2008;1(2):2.
73. Hanifin JM, Klas PA. The spectrum of cutaneous patch-test reactions in patients with atopic dermatitis. Clin Rev Allergy Immunol 1996;14(2):225-40.
74. Meikle A, Vaghadia H, Henderson C. Allergic contact dermatitis at the epidural catheter site due to Mastisol® liquid skin adhesive. Can J Anaesth 2012;59(8):815-6.
75. Widman TJ, Oostman H, Storrs FJ. Allergic contact dermatitis from medical adhesive bandages in patients who report having a reaction to medical bandages. Dermatitis 2008;19(1):32-37.
76. Worsnop F, Affleck A, Varma S, English J. Allergic contact dermatitis from Mastisol mistaken for cellulitis. Contact Dermatitis 2007;56(6):357-358.
77. Campbell K, Woodbury MG, Whittle H, Labate T, Hoskin A. A clinical evaluation of 3M no sting barrier film. Ostomy Wound Manage 2000;46(1):24-30.
78. Neander KD, Hesse F. The protective effects of a new preparation on wound edges. J Wound Care 2003;12(10):369-71.
79. Egawa M, Oguri M, Kuwahara T, Takahashi M. Effect of exposure of human skin to a dry environment. Skin Res Technol 2002;8(4):212-8.
80. Imhof RE, de Jesus ME, Xiao P, Ciortea LI, Berg EP. Closed-chamber transepidermal water loss measurement: microclimate, calibration and performance. Int J Cosmet Sci 2009;31(2):97-118.