

# MARSI

## Medical adhesive-related skin injuries

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### Introduction

Medical adhesive-related skin injury (MARSI) is prevalent, under-recognised and preventable, and can occur in any patient group or setting. When superficial layers of skin are removed by medical adhesive, it not only affects skin integrity, but causes pain, increases risk of infection, and potentially increases wound size and delays healing, all of which reduce patient quality of life. The presence of one or more intrinsic or extrinsic factors increases the risk that MARSI will occur when medical adhesives are used. It is important to assess the patient and skin in order to devise the most appropriate care plan. Prevention can be implemented through steps in four broad categories: skin preparation, selecting appropriate medical adhesives, adhesive product application and adhesive product removal.

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### PREVALENCE OF MEDICAL ADHESIVE-RELATED SKIN INJURIES (MARSI)

Medical adhesive-related skin injury (MARSI) is a prevalent, under-recognised and preventable complication that occurs across all care settings, age groups and patient types, from healthy patients in ambulatory care, to patients with multiple comorbidities in critical care (McNichol et al, 2013). MARSI has been defined as “an occurrence in which erythema and/or other manifestation of cutaneous abnormality (including, but not limited to, vesicle, bulla, erosion, or tear) persists 30 minutes or more after removal of the adhesive” (McNichol et al, 2013). There are three main categories of MARSI, and a variety of subtypes (Figure 1).

There is evidence to show incidence of adhesive-related injuries. For example, these injuries have been reported as the most common source of skin breakdown in neonatal intensive care units (Kuller-McManus, 2001).

In elderly patients, the incidence of these injuries is higher. In a nursing home-based study, an overwhelming 98.6% of registered nurses surveyed indicated that skin tears were “common” to “extremely common” among their elderly patients (White, 2001). A survey of hospital-based nurses found that nearly all (n=41) respondents had treated MARSI in the 12 months leading up to the survey, with a MARSI incidence rate of 7.1% and an average of 2.8

Figure 1: Types of MARSI








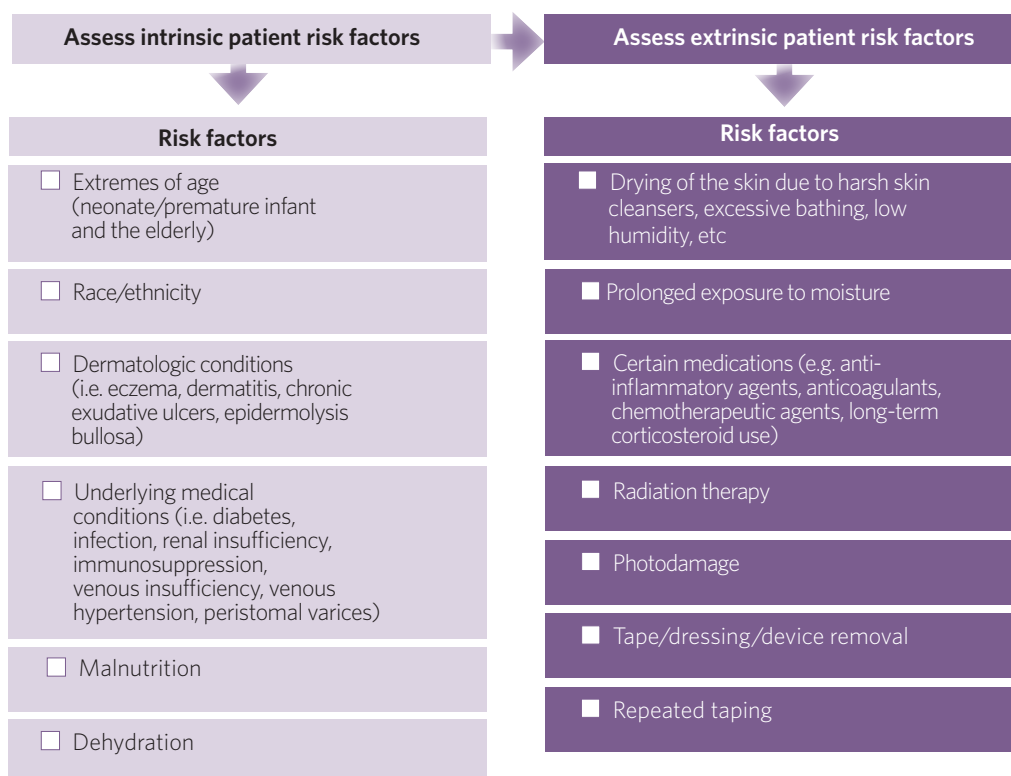
| Mechanical                         |  |   |
|------------------------------------|--|---|
| <b>Skin (epidermal) stripping</b>  | Removal of one or more layers of the stratum corneum following removal of adhesive tape or dressing  |    |
| <b>Tension injury or blister</b>   | Injury caused by shear force as a result of distension of skin under an unyielding adhesive tape or dressing   |    |
| <b>Skin tear</b>                   | Wound caused by shear, friction and/or blunt force resulting in separation of skin layers; can be partial- or full-thickness   |   |
| Dermatitis                         |  |   |
| <b>Irritant contact dermatitis</b> | Non-allergic contact dermatitis occurring as a result of a chemical irritant; a well-defined affected area correlates with the area of exposure  |  |
| <b>Allergic dermatitis</b>         | Cell-mediated immunologic response to a component of tape adhesive or backing; typically appears as an area of erythematous vesicular, pruritic dermatitis corresponding to the area of exposure and/or beyond |  |
| Other                              |  |   |
| <b>Maceration</b>                  | Changes in the skin resulting from moisture being trapped against the skin for a prolonged period; skin appears wrinkled and white/grey in colour  |  |
| <b>Folliculitis</b>                | Inflammatory reaction in hair follicle caused by shaving or entrapment of bacteria; appears as small inflamed elevations of skin surrounding the hair follicle   |  |

Figure 2: Two-part MARSi risk assessment



injuries per patient who suffered skin damage (Maene, 2013). Skin stripping and skin tears were the most common MARSi, followed by tension blisters and dermatitis (Maene, 2013). A study in an elderly patient population found that the incidence rate of MARSi was 15.5%, with the most common injuries being contact dermatitis, trauma and infection (Konya et al, 2010).

When considering the research, it is important to note that skin tears can be caused by factors other than MARSi, and that much of the existing research on skin injuries in general focuses on the use of medical tapes (LeBlanc and Baranoski, 2011). Clinicians are in the early stages of reporting and understanding MARSi and its causes.

### IMPORTANCE OF MARSi PREVENTION

When superficial layers of skin are removed by medical adhesive, it not only affects skin integrity, but causes pain, increases risk of infection, and potentially increases wound size and delays healing, all of which reduce patient quality of life (Cutting, 2008). In some cases, adhesives can also cause deeper tissue injuries beyond the loss of superficial skin layers (Denyer, 2011).

Although the injuries caused by medical adhesives may appear minor, care and management of MARSi can be costly in terms of nursing time and money: nurses report treating MARSi approximately five times a week, an average of 7.8 times per patient, and costs calculations put the average cost per MARSi

treatment application at ~€1.23—€8.86 (~£1.10—£7.90) per patient over the course of treatment (Maene, 2013).

### CAUSES OF MARSi AND CHALLENGES IN ITS PREVENTION

Perhaps because MARSi is so common, current thinking is that it is just part of life with medical adhesive use — a necessary evil. In addition, difficulties arise because MARSi may seem to occur despite best efforts at gentle removal, and clinicians may come to believe that nothing can be done.

In truth, although it is intuitive that MARSi occurs when the bond between adhesive and skin layers is stronger than that between the various skin layers — resulting in separation of skin cells upon adhesive removal — the pathophysiology is not fully understood (McNichol et al, 2013).

However, there are several causal factors that result in MARSi. Firstly, varying compositions of medical adhesives warrant careful consideration before selection: adhesives warm when pressed against the skin, filling in the gaps between the adhesive and irregularities in the skin surface (Zeng et al, 2016).

The traditional adhesives (acrylates, in particular) increase in strength over time, whereas silicone adhesives mould into the skin's irregularities more quickly, and maintain a constant level

of adhesion over time (Zeng et al, 2016). However, caution should be exercised when using silicone adhesives to secure some devices, as they may result in sub-optimal adhesion and dressing failure (McNichol et al, 2013).

Techniques used both to apply and remove medical adhesives should be examined as potential ways to decrease the incidence of injury.

Secondly, intrinsic patient factors (e.g. very young or very old age, underlying medical conditions) increase the risk of MARS (McNichol et al, 2013), and extrinsic and/or treatment factors (e.g. certain medications, repeated use of adhesives over a prolonged period) can influence the likelihood of injury (McNichol et al, 2013).

The condition and environment of the skin itself must be accounted for, to understand the level of skin integrity.

Furthermore, components of the adhesive may cause inflammation of the skin, resulting in irritant contact or allergic dermatitis-type MARS. These factors must be considered together when determining MARS risk and, subsequently, a prevention regimen.

## IDENTIFYING PATIENTS AT RISK OF MARS

The presence of one or more of these factors increases the risk that MARS will occur when medical adhesives are used. All should be assessed for and documented before choosing an appropriate medical adhesive (Figure 2, p2).

Underlying illness, extremes of age, immunosuppression, skin changes and/or existing skin injuries, and treatments for other medical conditions are the most significant indicators that MARS risk will be

elevated, and that steps for prevention should be initiated.

## CONCLUSION

For many patients, MARS is a preventable injury (Figure 3, p4). Adopting a focused, structured approach to risk assessment will help clinicians to choose the right product for each patient. Education incorporating skin preparation, adhesive selection and application and removal of adhesive products will also reduce the risk of MARS.

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## Box 1: Recommendations for use of barrier films (McNichol et al, 2013)

- Skin barrier products provide protection between the skin and adhesives, as well as providing protection against body fluids, wound exudate, urine and faeces
- Typically available as a liquid (wipes, foam applicators or spray), barrier films may contain silicones, acrylates, organic polymers or inorganic compounds in a solvent that evaporates to create a transparent, flexible, breathable, protective coating on the skin
- Some barrier films also include an added component (plasticiser) that allows flexibility in the applied product
- Barrier films reduce erythema and incidence of MARS and are therefore recommended for use in conjunction with medical adhesives, particularly in high-risk patients
- Use of barrier products in neonates and in the periwound and ostomy setting is particularly important, given the propensity for compromised skin integrity
- Do not use barrier films that contain alcohol in neonates, due to the potential for drying of the skin
- Silicone-based barrier films are often used in neonates outside of manufacturers' indications for use. Use of these barrier films has been described in neonates and premature infants but further research is needed.

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### Figure 3: Practical steps for minimising MARS

There are four broad categories for preventing and minimising incidence of MARS (Holloway and Jones, 2005; McNichol et al, 2013; Wounds UK Expert Panel, 2014; Davis, 2016). It is important to implement a multi-factorial MARS-prevention regimen — including thorough assessment

#### Skin preparation

- Remove excess hair by trimming or using clippers — no shaving
- Determine and address any causes of excess moisture — e.g. sweating, urine or leakage from a wound or drain
- Assess skin maceration and oedema and initiate management for the underlying conditions
- Be sure skin is clean and dry
- Apply protective alcohol-free barrier film (Box 1, p3)

#### Choosing appropriate medical adhesives

- Consider the results of the two-part assessment (Figure 2, p2)
- Consider the anatomy over which the adhesive will be placed. For example, is the area contoured (e.g. sacrum) or flat (e.g. arm), and is there potential for the skin to stretch due to factors such as oedema, distention and movement?
- Consider length of wear time, as many adhesives bond more strongly to skin the longer they are in contact
- Match these factors against both the risk-level of the skin and the requirements for medical adhesive use (Table 1, below)
- Use the lowest level of adhesion required to secure the device or dressing, and use tape with stretch where possible or needed
- Consider newer adhesive products such as silicone adhesive where adhesion is needed but skin is at risk
- A note on silicone adhesives: although they are softer and have a lower surface tension, letting them fill gaps in skin irregularities quickly and gently, these products may be less moisture-resistant than traditional adhesives, and more research is needed into their use, efficacy and prevention of skin injuries

and identification of at-risk patients, appropriate skin preparation, appropriate selection of medical adhesives, best practice application and removal of adhesives — to reduce incidence of MARS.

#### Adhesive product application

- Provide standardised staff training in adhesive product application
- Do not routinely use tackifiers
- Use sufficient, appropriate pressure to gain adhesion
- Cover adequate surface area to evenly distribute adhesion tension
- Obtain full contact — ironically, gaps will cause more tension in the adhesive area that has contact with the skin, increasing risk of MARS
- Tape or dressing should be long enough to extend to 1.25cm (2.5cm is preferred) beyond the dressing or device
- Orient tape/dressing to allow stretch (i.e. in the direction of expected swelling or movement)
- Apply tape/dressing without stretch or tension: replace arylate tape or reposition silicone tape if swelling/distention occurs
- Apply gentle, firm pressure after application, stroking the tape in place

#### Adhesive product removal

- Provide standardised staff training in adhesive product removal
- Remove at a low profile to the skin; gently, slowly and evenly
- Consider the use of a specialised medical adhesive remover
- Removing dressings too frequently can cause unnecessary trauma to the skin and potentially delay wound healing, therefore remove dressings only when there is an indication to do so (e.g. due to exudate levels)
- Remove tape/dressing slowly, keeping tape horizontal and close to the skin
- Remove in the direction of hair growth
- Support exposed skin at the peel line as tape/dressing is removed.

Table 1: Level of adhesion consideration

| Critical securement   | Multipurpose  | Gentle to skin  |
|---|---|---|
| <b>Securing medical devices</b><br>Heavy tubing (e.g. endotracheal tube, chest tube nasogastric tube) | <b>Securing medical devices (e.g. ostomy bag)</b><br>Immobilising body parts        | <b>Anchoring dressings</b><br>Lightweight tubes/devices (e.g. IV)                     |
|                    |  |  |

← Higher level of adhesion

Moderate level of adhesion

Lower level of adhesion →

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