Medical Adhesive Safety

Last fall, an expert panel published recommendations for reducing the risk of adhesive-related skin injuries.1 Given the 1.5 million injuries related to adhesive removal annually,2 it’s remarkable that the only English-language guidance published before this was limited to neonates. We’ll cover tape information here, and urge you to read the full guidelines for more about skin care and types of damage related to tape use.

Tape 101

While we use medical tape every day, most of us have had very little education about the components that make up a roll of tape, the different types of tape and indications for each. The FDA defines a medical adhesive as “a strip of fabric material or plastic, coated on one side with an adhesive, and may include a pad of surgical dressing...The device is used to cover and protect wounds, to hold together the skin edges of a wound, to support an injured part of the body, or to secure objects to the skin.” While medical adhesives can be tapes, dressings or devices, we’ll use the term tape generically.

There are four layers in a traditional medical adhesive:
The release coating prevents the adhesive from sticking to itself so that it’s easy to remove the tape from the roll. Generally speaking, the backing can be paper, plastic, cloth, foam and/or elastic;1 adhesives can be natural (latex) or synthetic (non-latex) rubber, acrylic, or silicone. The combination of the layers determines the properties and clinical performance of the product, and you must evaluate them together. The backing layer provides tapes with most of their cohesive mechanical strength and determines whether the tape is stiff or conforming, whether skin under the tape is visible, and the degree of permeability to gases and water vapor.1,2

Since medical tapes need to adhere to skin, their properties are very different from tapes designed for other purposes. The skin surface is continually sloughing, so the tape needs to adhere to a surface being shed; the surface has water, oil, salt, loose debris and often lotion or cream; the skin is highly lipid, making it hydrophobic; and it has elastic properties.3 In addition, the skin surface is very irregular with ridges and valleys.4

If that’s not enough, tapes need to be able to handle moisture vapor that normally leaves the skin. This is called the moisture vapor transmission rate (MVTR), and it depends on the chemical composition of the adhesive, the tape thickness and the permeability of the backing.3,5

Finally is biocompatibility – the tape must be nontoxic, hypoallergenic, and compatible with skin cells. When you consider that most standards for routine adhesive testing call for tape to stick to stainless steel, you can see how complicated skin adherence is. The ideal tape must be compatible with skin, adhere strongly, be permeable to air and moisture, and remove gently without skin trauma.3 Unfortunately, those that have the strongest securing properties are usually very difficult to remove.2

Getting Technical

Tapes are called pressure sensitive adhesives (PSA), meaning they adhere to the surface best with application of light pressure on the backing.3 Do you always apply pressure when you put tape on the skin? Over time, adhesive will warm and flow to fill gaps in the skin surface, strengthening the bond.1

There are three measures of adhesive strength – tack is the quick initial adhesion before pressure is applied; peel adhesion is the ability to resist removal by peeling, peel force is the force required to remove the adhesive from the surface; and shear is the ability to maintain a bond when loaded – the load can be securing a weighty device to the skin or trying to conform a stiff tape to a curved surface.1,5 Clinicians typically assess tape by how sticky it feels – the tack – but that has little to do with adhesion to the skin. It seems like the greater the peel force, the greater the potential skin damage, but silicone adhesive on a foam backing had less damage with a moderate pull force while hydrocolloid adhesive on a foam backing had more damage with a lower pull force.6

MARI

The expert panel standardizes the name of skin damage relating to tape as medical adhesive-related skin injury (MARI) and defines it as “…erythema and/or other manifestation of cutaneous abnormality (including, but not limited to vesicle, bulla, erosion, or tear)[that] persists 30 minutes or more after removal of the adhesive.”1 Injury occurs when the adhesive bond between the tape and the skin’s surface is stronger than the bond between skin layers, leaving skin attached to the tape as it is removed. While multiple factors contribute to injury, including peel force, adhesive characteristics, occlusiveness, and rigidity of the backing, patients at both ends of the age spectrum are at greatest risk, along with those who are malnourished or dehydrated.1,6 A study of persons age 65 and older found 71% of MARI were contact dermatitis, 21% trauma, and 9% infection.7 True allergies to adhesive are rare; contact dermatitis is much more common.1,6

Adhesive Selection

When selecting the tape product, consider both patient and product characteristics:1

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In the Literature

Enhancing ICU Rounds

An article in the current issue of Critical Care Medicine reports on a study describing implementation of a daily goal checklist to facilitate morning ICU rounds. The checklist is broken down by comfort, sedation, safety, and prophylaxis; lines, tubes and drains; fluid status; infection prevention; ventilation; nutrition; diagnostics; meds; psychosocial; research; and consultations. A pre-rounds section is completed by the overnight nurse, and the rounds section is addressed by the whole team. Key benefits of the process were: rounds more systematic and organized, multidisciplinary input was facilitated, checklist is a centralized concise summary of the plan, ensures comprehensive approach to care, emphasizes patient-specific goals, and enhances teaching on rounds by prompting teaching topics. If you’re looking for ideas to improve your rounds checklist, this is a great resource.

Source: Centofani, J.E. et al: Use of a daily goals checklist for morning ICU rounds: a mixed-methods study. Critical Care Medicine 2014;42(8):1797-1803. PubMed Citation

A New Alcohol Intoxication Scale

The current issue of the Journal of Emergency Nursing includes a study describing development of a behavior-based tool for assessing level of intoxication created in response to logistical challenges holding up transfers that were based on blood alcohol (BAC) levels. Since there is not a great correlation between BAC and behavior, this new tool facilitates decision-making for intoxicated patients’ transfers.


A New Angle on Nurse Bullying

Researchers writing in the latest issue of the Journal of Nursing Scholarship note that bullies who shout and scream are easy to identify, but most bullying in nursing is far more subtle. The researchers examined the “manner of speaking” – rhythm, stress, intonation, word choice and physical presence – that they call prosody. Commonalities were a culture in which this behavior was expected by victims and tolerated by others, bullies use lies and choose and shape facts selectively, and victims were overwhelmed by their public shaming. While this article is not an easy read, it’s an important contribution on a vital topic.


Continued from page 1

- Is the tape needed to secure a critical (essential to patient safety) or noncritical device or dressing?
- How long will the tape be in place?
- Is the skin area smooth or contoured; likely to move or come under friction; dry or exposed to moisture, perspiration, humidity, exudate or body fluids?
- What is the strength of the tape over time?
- Does the tape stretch, breathe, conform to the area; is it flexible and strong?

Remember that developing or resolving edema causes significant skin movement.

Do and Don’t

The panel’s recommendations include practices to follow and those to avoid:

- Consider using a barrier film to protect skin, but avoid alcohol or solvents on neonates
- Avoid substances that are tacky and increase adhesion such as tincture of benzoin
- Dedicate tape roll(s) for single-patient use to minimize contamination
- Do not put tape strips on bed rails, IV trays or any other surface; do not carry rolls in pockets or on stethoscopes to keep tape clean
- Make sure skin is clean and dry before applying tape
- Avoid stretching tape; apply without tension or pulling on underlying skin

Looking at the Future

A group in Boston may have come up with a tape that adheres strongly yet removes easily without trauma. While others have tried manipulating the backing or the adhesive, these researchers add a release layer between the backing and the adhesive. When it’s time to remove the tape, the release layer separates the backing from the adhesive. This leaves only the adhesive on the skin, which can then be simply rolled off. The residual tape has 93% less adhesive force compared with the full tape. If rolling the adhesive causes trauma, it can be inactivated with talcum powder, and then serve as a base for reapplying tape. Researchers’ next step is getting approval for testing on humans.

Table 1 provides the characteristics of various adhesives and backings. Table 2 provides an overview of applications using generic terms. Table 3 lists recommendations for applying and removing tape with minimal skin injury.

Sources


Critical care training programs are putting more of their educational content online and sharing their curricula and research with all who are interested.

The MarylandCCProject is an open-source project created and maintained by the University of Maryland Critical Care fellows. http://marylandccproject.org

Surgical Critical Care / Acute Care Surgery is the site from the Orlando Regional Medical Center’s fellowship program in Florida. http://surgicalcriticalcare.net/
These tables provide an overview of characteristics of adhesives and backings. However, it is the combination of the adhesive with the backing that ultimately determines the tape’s effects on the skin. Different manufacturers give their tapes brand names without specifying the type of adhesive or backing. Unfortunately, that means we can’t provide specific recommendations here. You’ll need to check with the manufacturer(s) of the tapes in your practice setting.

**TABLE 1A ADHESIVE**

<table>
<thead>
<tr>
<th>Adhesive</th>
<th>Tack</th>
<th>Peel adhesion</th>
<th>Cohesive strength</th>
<th>Air permeable</th>
<th>MVTR</th>
<th>Skin Trauma</th>
<th>Cost</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural rubber latex</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Poor</td>
<td>Poor</td>
<td>High</td>
<td>Low rising</td>
<td>Water resistance</td>
</tr>
<tr>
<td>Synthetic rubber</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Poor</td>
<td>Poor</td>
<td>High</td>
<td>Low</td>
<td>When bond strength essential, water resistance</td>
</tr>
<tr>
<td>Acrylic / Acrylate</td>
<td>Variable, typically low</td>
<td>Medium to high</td>
<td>Variable</td>
<td>Variable</td>
<td>Good</td>
<td>High</td>
<td>Mid</td>
<td>Most diverse, strong, durable, designed to replace natural rubber, adhesion increases over time; variability related to backing</td>
</tr>
<tr>
<td>Silicone</td>
<td>Variable</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>Fair</td>
<td>Low</td>
<td>High</td>
<td>Can reposition, gentle to sensitive skin, adhesion does not increase over time</td>
</tr>
<tr>
<td>Hydrocolloid</td>
<td>Varies over time</td>
<td>Variable</td>
<td>More over time</td>
<td>Variable</td>
<td>High</td>
<td>Absorb fluids, can cause stripping on removal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tack: initial “grab” upon contact, Peel adhesion: force required to break adhesion between tape and surface, Cohesive strength: measure of the internal strength of the adhesive itself – the ability to remain intact under stress, MVTR: moisture vapor transmission rate.

**TABLE 1B BACKING**

<table>
<thead>
<tr>
<th>Backing</th>
<th>Adhesive</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloth</td>
<td>Acrylic or synthetic rubber</td>
<td>Molds to surface, gas permeable</td>
<td>Not water resistant, does not stretch, increased risk for tension blisters</td>
</tr>
<tr>
<td>Cloth</td>
<td>Natural rubber</td>
<td>Strongest hold, tolerates moisture and secretions</td>
<td>Most likely to damage skin, may not be available in latex-free facilities</td>
</tr>
<tr>
<td>PVC Foam</td>
<td>Acrylic</td>
<td>Cushioning, stretches, good for joints or where movement needed, waterproof, hypoallergenic</td>
<td></td>
</tr>
<tr>
<td>Film</td>
<td>Acrylic</td>
<td>Transparent, can be occlusive or permeable</td>
<td></td>
</tr>
<tr>
<td>Paper</td>
<td>Silicone</td>
<td>Gentle to skin, low sensitivity, removes easily</td>
<td>Not recommended for critical securement Less tolerant of moisture</td>
</tr>
<tr>
<td>Plastic</td>
<td>Silicone</td>
<td>Gentle to skin, low sensitivity, removes easily</td>
<td>Not recommended for critical securement Less tolerant of moisture</td>
</tr>
</tbody>
</table>

**TABLE 2 APPLICATIONS**

<table>
<thead>
<tr>
<th>Backing</th>
<th>General Applications</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Silk”</td>
<td>Securing tubes and devices, bulky dressings, finger and toe splints</td>
<td>Not flexible, adheres strongly to dry skin, long-term adhesion</td>
</tr>
<tr>
<td>Cloth</td>
<td>Securing ET tube, NG tube, chest tubes &amp; drains, splints, critical securing</td>
<td>May have natural rubber (latex) adhesive, strongest adhesion on dry skin, strong securing in moist skin conditions</td>
</tr>
<tr>
<td>“Soft” cloth</td>
<td>Areas where skin may stretch, dressings</td>
<td>Recommended for sensitive skin</td>
</tr>
<tr>
<td>Paper</td>
<td>Small to medium dressings, moist skin, lightweight tubes</td>
<td>Recommended for fragile skin, permeable</td>
</tr>
<tr>
<td>Plastic</td>
<td>Securing tubing and devices, bulky dressings</td>
<td>Check whether occlusive or permeable; occlusive is waterproof &amp; will protect from fluids but will not allow vapor to leave skin</td>
</tr>
<tr>
<td>Foam</td>
<td>Dressings that move, such as joints; compression or pressure dressings; cushioning</td>
<td>Will stretch, water resistant</td>
</tr>
<tr>
<td>Silicone</td>
<td>Securing dressings</td>
<td>Most gentle on skin</td>
</tr>
</tbody>
</table>

Product literature from 3M, Covidien, Cardinal Health, Vancive Medical Technologies
TABLE 3 APPLYING AND REMOVING TAPE

<table>
<thead>
<tr>
<th>Apply</th>
<th>Remove</th>
</tr>
</thead>
</table>
| **Prepare Skin**  
Clip hair if needed  
Apply barrier, if indicated (be sure it is completely dry)  
**Select Tape**  
Choose tape based on application and skin condition  
Extend tape at least ½ inch beyond dressing  
**Place Tape**  
Put tape on the skin without tension; do not pull or stretch  
Check that there are no gaps or wrinkles  
Gently, but firmly press the backing to activate the pressure sensitive adhesive & maximize adherence  
For compression: stretch tape over dressing only, not over skin | Loosen edges of tape  
Stabilize the skin with fingers of the other hand, pushing skin down and away from tape  
Lift tape in direction of hair growth, keeping it horizontal and close to the skin surface, slowly pulling it back over itself  
As tape is removed, move fingers to continue to support newly exposed skin near the tape removal point  
Do not raise tape at a high angle to the skin |