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ABSORBENCY TESTING OF WOUND DRESSINGS

It is highly unlikely that a single absorbency test could differentiate between different wound dressings (even apparently simple categories such as dressing pads or foam dressings). It may well be possible to differentiate dressings within a particular category into low, medium and high absorbency categories. But to do so, the absorbency testing used will need to relate to the clinical circumstances envisaged and to the design of the dressings. And no one test method is likely to be sufficient.

This is the reason why so many absorbency test methods have been developed – tests appropriate for a gauze pad would be entirely inappropriate for a superabsorbent dressing, and so on. Differentiated absorbency tests appear in British Standards, European Norms, ASTMs, International ISO Standards, Pharmacopeias, DHSS specifications, amongst several other sources.

As a minimum, any testing of absorbency for a wound dressing is likely to need to consider:

- Unconstrained free absorbency
- Absorbency under load (different loads for taping in place, held by bandages, or under compression bandages)
- Wicking
- Time or volume to strikethrough
- Speed of absorbency

and understand the difference between absorption and adsorption. Taking each of these in turn:

Unconstrained Free Absorbency

This is a measure of the maximum absorbency of a dressing, with all parts of the absorbent element fully saturated. There are several methods used, but they generally come down to weighing a sample, dunking it in a test fluid for a period, pulling it out and letting it to drain, before weighing it again to see how much test fluid has been absorbed. The result is usually expressed as ml/g or g/g.

Apparently straightforward, it can also be misleading – especially for something like a foam dressing or dressing pad. This is because:

- A foam dressing usually has a cellular structure, something like a sponge. So if any pressure is supplied to the product, some of the absorbed fluid will be expelled. The greater the pressure, the more that is expelled. How great this effect is depends critically on the compressibility of the foam.
- In use, a foam dressing is unlikely to be unconstrained – they will be held in place by tape, or under a dressing-retention bandage, or under a compression bandage system. Each of these will place an increasing pressure on the dressing and effectively squash it – reducing its thickness. Reducing the thickness will reduce the volume available to absorb fluids, thus reducing the absorbency. The more the pressure applied, the more the absorbency is reduced.
- Wound exudate and blood are far more sticky and viscous than water or saline. Yet many free absorbency tests just use water or saline. The problem is, of course, that sticky and viscous fluids are absorbed far less readily than saline or water. Hence test methods based on saline or water as a test fluid can only be considered as indicative. This also explains why suppliers often provide absorbency results for test fluids of varying viscosity.

- The test indicating the maximum amount a dressing can absorb says nothing about how fast it can absorb, nor how well it can retain what has been absorbed. If a dressing cannot absorb wound exudate fast enough then pooling of exudate can occur – with possible unfortunate results. If a dressing cannot retain what it has absorbed, then strikethrough and pooling can occur. In both cases a fluid pathway from the wound to the external environment can occur – thus providing a potential pathway for infection.

Interestingly, the chemical characteristics of the test fluid can greatly affect absorbency results. For example, with superabsorbent (SAP) dressings distilled water will give the highest result, with saline producing a noticeably lower result, and fluids containing calcium or other ions a yet lower result in some cases (but note that some superabsorbent systems actually need calcium ions present to create cross-links and thus absorb into a gel). Hence it is always important to specify the test fluid (whilst recognising that many test fluids may not match the clinical circumstances).

A particularly useful comparison of the functional properties of superabsorbent dressings (Browning et al., 2016) suggests that when *'assessing the key performance characteristics of absorbency, moisture vapour transmission rate (MVTR), strikethrough and structural integrity, results show that SAPs are not all the same – in fact each of them varies considerably and may lend themselves to different wound aetiologies and usage conditions'*.

Absorbency under Load – Constrained Absorbency

These test methods attempt to measure the absorbency of the dressing under specific loads – to better represent clinical circumstances. The load applied would depend on the clinical circumstance, e.g. under tape, under a dressing-retention bandage, or under a compression bandage system. Each of these will place an increasing pressure on the dressing and effectively reduce the absorbency of foam dressings (although the effect may be less for superabsorbent dressings). Hence the following need to be taken into account:

- Each clinical situation would need to specify an appropriate applied pressure.
- The test methods used would need to be specified, as different methods are likely to produce differing results.
- The tests are carried out in a static (unmoving) situation, whereas dressings are usually applied on a patient and can thus be flexed and moved whilst in situ. Any flexing and movement could act to expel absorbed fluid and thus act as a limitation to absorbency.
- These tests will be strongly affected by the viscosity of the test fluid. Wound exudate and blood are far more sticky and viscous than water or saline. Yet many constrained absorbency tests just use water or saline. The problem is, of course, that sticky and viscous fluids are absorbed far less readily than saline or water. Hence test methods based on saline or water as a test fluid can again only be considered as indicative.
- In clinical circumstances the load across a dressing will vary – whereas in the test methods it is held constant.

Wicking

These test methods attempt to measure how efficiently a dressing uses the available absorbency. Wicking is term that defines how far exudate (or test fluid) can travel within the absorbent medium. In a dressing with a low wicking ability, only a small fraction of the absorbent pad would be used – and the dressing would thus only use a fraction of the total absorbency (thus representing another reason why total free absorbency can be misleading). Conversely, a dressing with a good wicking can make much greater use of the available absorbency. However:

- Wicking ability depends critically on the construction of a dressing and differ significantly between apparently similar-appearing dressings. Hence the actual absorbency can differ greatly depending on the wicking ability.

- Wicking can also be too high. If a dressing wicks too quickly, then a fluid pathway can quickly be established through the dressing. Once a fluid pathway is present it offers a potential path for infection. Consequently, good practice is to change a dressing once the fluid pathway has been formed – this is called strikethrough. If wound exudate can be observed on the upper side of a dressing it has struck-through and should be changed. So too great a wicking ability can reduce the in-place life of a dressing (and thus reduce its cost-effectiveness).
- Getting a balance between wicking and absorbency can often lead to a dressing have a layered structure – with different layers having different absorbency properties. The layered structure can often help maximise actual absorbency in use and product lifetime in use. However, the result is a more complex product that can react rather differently to test methods. For example, a simple free absorbency test might show a simple foam dressing to have a higher absorbency, yet show a layered dressing to have a much lower absorbency – yet the latter may well absorb far more in actual use.

Absorbency to Strikethrough

Some test methods attempt to take better account of the real circumstance. They have a defined source of test fluid, above which the test sample is placed. Test fluid is then applied at a rate equivalent to exudate production in a real wound circumstance. The absorbency is then measured at the point at which strikethrough occurs and a fluid pathway is formed. However:

- The rate of wound exudate can vary greatly in practice – depending on the type of injury, the age of injury, the clinical circumstance, and idiosyncratic patient effects. So the rate of test fluid applied in these tests needs to be relevant to the clinical circumstances envisaged for the products.
- The test equipment used can be quite complex and may be specifically designed for a particular type of dressing

Speed of absorbency

It is self-evident that a dressing needs to have an speed of absorbency relevant to the clinical uses. In emergency situations a very high rate of absorbency can be needed (as might be found with gauze and cotton dressings), whereas a clinical wound might only need a modest rate of absorbency (as might be found with some post-op dressings).

Test methods differ greatly, from simple sink-time methods (as defined in the British Pharmacopeia) to specially-constructed test rigs.

Some dressings can have a layered structure, with a facing layer designed to absorb quickly and a backing layer designed to maximise available absorbency.

It is actually the case that the rate and efficiency of absorption can be too good – leading to undue drying of the healing wound, thus providing a less than optimum wound environment (e.g. too dry for moist wound healing to take place). This might happen, for instance, if a high-performance superabsorbent dressing was inappropriately applied to a low exudate wound.

Moisture Vapour Permeability

Although not strictly a measure of absorbency, it is an important measure of how well dressings allow a wound to 'breathe'. An impermeable dressing would not allow a wound to breath – and, if exudate was being actively produced, could allow it to pool under the dressing – potentially leading to maceration and poor wound healing. Conversely, a dressing that is too porous might allow the wound to dry out to the point where moist wound healing could not occur. Consequently, there will be an optimum permeability that depends not on the dressing, but upon the clinical circumstance.

The actual test methods measure the Moisture Vapour Transmission Rate (MVTR) using highly-specialised laboratory equipment.

Other test methods and critical properties

Measuring the absorbency of a dressing will not in any way indicate:

- The flexibility and conformity of a dressing – and hence the patient comfort. A lack of flexibility and conformance can lead to both pain and potential damage to the healing wound. Hence test methods on both surface conformity and flexibility exist.
- The adherence of a dressing to a wound. An apparently high absorbency dressing could well have a propensity to adhere (stick) to the healing wound (as is well-known to occur if gauze is used as a primary dressing). Any adherence can lead to both pain and damage to the healing wound on removal. Hence, non-adherence test methods are an important aspect of the assessment of many dressings.
- The strength of a dressing. Here we can be talking tensile strength, tearing strength, shear strength, adhesive strength. Dressings need to be strong enough to be used and removed without breaking or tearing and making debris available to a healing wound. Adhesive dressings need to adhere to skin well enough to hold the dressing in place, but not so well they damage the skin on removal. Hence there are dozens of test methods available to measure the various physical strengths of dressings. Again, it is the clinical situation that determines which are important and what result would be optimum
- The biological safety of the dressing. Clearly, no dressing should produce an irritant or allergenic reaction – and again there are a battery of test methods available
- Whether the dressing has antibacterial or bacteriostatic properties
- Whether the dressing has any adsorptive or odour suppression properties (as found, for example, with carbon dressings)
- Whether the dressing provides physical protection to the leaking wound – measured by impact absorption tests
- How the dressing will react to sterilisation, how it will age, how long it can be stored, and so on

There is actually many more, and the above should be taken as examples.

Overall comments

There is no absorbency test method that can, in isolation, differentiate dressings in a way meaningful to the clinical situation. However, a carefully chosen group of test methods can provide indications for specific clinical circumstances.

There are no accepted general benchmarks for absorbency and related test methods – as any test method will need to be relevant to both the clinical circumstances and the dressing construction. This is the reason for sub-categories being shown in the SDMA Product Categorisation, for example with foam dressings. A lower absorbency foam dressing is likely to be used in a different clinical circumstance to a higher absorbency version, which will impact on the choice of appropriate test methods.

It should be noted that the MDR (Medical Device Regulation) will require appropriate clinical evidence to be generated for all products.

References

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