The use of gauze: will it ever change?

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ABSTRACT

Although the benefits of healing in a moist environment have been published worldwide, the use of woven gauze as a wound contact material still prevails in many countries. This article traces the history of gauze and problems associated with usage against the introduction of one of the first modern materials, the hydrocolloid. Why this revolution in dressing material did not herald an immediate change of practice away from gauze is examined. Since the 1970s, the range, availability and sophistication of these and other moisture-retentive dressings have increased dramatically, and yet it seems that some practitioners remain unconvinced. The processes that underpin personal and organisational change that may contribute to this reluctance are also considered.

Key words: Change ● Gauze ● Hydrocolloids

HISTORY OF GAUZE USAGE

Gauze is often used as a generic term to cover a wide range of dressing products. However, gauze products have numerous subcategories that differ according to fabric construction or material composition. The two major groups are referred to as (i) woven or (ii) non-woven. It is important that practitioners differentiate between these subcategories as product characteristics, and performance will differ within each group (1).

Non-woven gauze dressings are generally made of rayon or synthetic fibre blends. Not to be confused with woven gauze, these dressings were introduced to replace woven products as they have a lower adherence to the wound bed and are less likely to release lint (1,2).

Woven products, often referred to as absorbent gauze, are generally made of 100% natural cotton yarns and have been manufactured the same way for centuries. It is this type of gauze that has the potential to cause more problems than any other, as it will shed fibres when cut and is prone to linting with fibres remaining in the wound after dressing removal (2,3). Woven gauze is the oldest dressing still in use and dates as far back as the Ancient Egyptians who used it to wrap bodies prior to burial.

Prior to the 1960s, gauze was used for all wound types and was especially useful for the extensive injuries inflicted on soldiers during combat. Used in large quantities, woven gauze dressings were able to absorb wound exudate and provide the type of environment that would allow the wound to form an eschar (4).

Although there was little else available, it was viewed as an acceptable dressing as, at that time, it was assumed a dry wound environment would facilitate the death of bacteria (5).

This drying process was also seen to aid debridement of the wound, because as the gauze dried the non-viable tissue would adhere to and be removed when the dressing was taken off.

Before the advent of moisture-retentive cavity dressings, packing of a cavity wound with gauze, both perioperatively and postoperatively, was also a common practice. Ribbon gauze was moistened with antiseptics such as EUSOL, Proflavin and Chlorhexadine and packed tightly into the wound cavity. Although never substantiated, the theory was that this would keep the wound margins apart, allowing the wound to granulate from the base upwards.

Key Points

- gauze is often used as a generic name to cover a wide range of dressing products
- non woven gauze dressings are generally made of rayon or synthetic fibre blends; introduced to replace woven products as they have a lower adherence to the wound bed and are less likely to release lint
- woven products, often referred to as absorbent gauze are generally made of 100% natural cotton yarns; they have the potential to cause more problems as they will shed fibres when cut and are prone to linting with fibres remaining in the wound after dressing removal

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Key Points

- frustrated with the limitations of the basic dressings available at the time Bloom, a Second World War army surgeon, designed a dressing of sterilised cellophane to cover exposed wounds
- covering this dressing with gauze demonstrated that exudate passed through cellophane into the gauze, a technique that allowed patients to move without pain and prevented loss of plasma
- further development of materials in the form of nylon-derived semi-permeable film and investigative studies were demonstrating that wounds epithelised at a faster rate when kept moist under the cover of a polythene film
- the production of the first hydrocolloid dressing in 1982 extended the scope of dressing choices for practitioners and heralded a new era of wound management products

Research carried out on the effect of antiseptics began a crusade in United Kingdom (UK) nursing journals that led to a ban on their use in wound management. This movement was predominately based on the work carried out by Brennan and Leaper (6), as they demonstrated that certain antiseptics appeared, at least *in vivo*, would delay healing.

The focus was taken away from the use of gauze as a potentially harmful dressing material, to the solution in which it was soaked and nurses began to replace antiseptics with physiological saline. This failed to address the issues regarding the use of gauze, with practitioners believing that they were now using a harmless solution, that is saline on the wound surface.

Saline is an isotonic solution, but as water evaporates from the saline dressing, it becomes hypertonic and draws fluid from the wound into the gauze. Unless the gauze is re-moistened, the packing quickly dries out, becoming a hard ball. Subsequent removal will be painful for the patient and may even require a further visit to the operating theatre. However, these problems were often ignored or diminished as attention was drawn towards the antiseptic debate. It remains questionable whether the use of antiseptics was the real cause for concern, as solutions were generally never in contact with the wound in sufficient quantities or long enough to do the patient harm.

INTRODUCTION OF MODERN WOUND DRESSINGS

Frustrated with the limitations of the basic dressings available at the time, Bloom (7), a Second World War army surgeon designed a dressing of sterilised cellophane which he used to cover exposed wounds in preference to tulle-gras. This material was, at that time, made of rubber, waterproof and largely unsuitable as it caused maceration. Also due to its rigidity, it was very brittle and frequently liable to crack.

However covering this dressing with gauze, he demonstrated that exudate passed through the cellophane into the gauze, a technique that allowed patients to move without pain and prevented loss of plasma.

Further development of materials in the form of a nylon-derived semi-permeable film was investigated by Bull *et al*. (8) in 1949 and later by Schilling *et al*. (9). Gilje, a Norwegian dermatologist, also published work at this time which had been carried out on patients with venous leg ulcers where it was noted that the portion of the ulcer covered by adhesive tape epithelised faster (10).

Although the concept of healing in a moist environment was being established, it was not until Winter's (11) findings that, the further development of dressing materials began to gather momentum. Reporting on the results of two experiments in partial-thickness swine excisions, he demonstrated that wounds epithelised at a faster rate when kept moist under the cover of a polythene film.

Subsequent studies by Hinman and Maibach (5) on similar experimental wounds in humans were also favourable and led to the production of the first semi-permeable film dressing Opsite®.

Although film dressings were an exciting development for practitioners, their use was limited to shallow wounds with light, to moderate exudate and therefore for many wound types were not a natural alternative to gauze. The production of the first hydrocolloid dressing in 1982 extended the scope of dressing choices for practitioners considerably, heralding a new era of wound management products (4,12,13).

Granuflex® (or Duoderm®) had a complex structure, consisting of an inner layer of hydrocolloid material made of a mixture of gelatin, pectin and sodium carboxymethylcellulose (CMC) plus polyisobutylene contained in hydrophilic gel (14).

The combined film/foam backing was also able to act a thermal insulator and a barrier to micro-organisms in either direction (15).

Hydrocolloids had the capacity to absorb wound fluid and form a gel over the wound bed, and as earlier attempts to produce dressings without causing maceration had failed, this was a major step forwards.

These new hydrocolloid dressings allowed the wound to remain moist, but controlled water beneath the dressing, passing it to the external environment thus decreasing the risk of maceration. This mechanism depended partly on the moisture vapour transmission rate (MVTR) of the backing layer, partly on the absorptive capacity of the hydrocolloid layer. The controlled uptake of wound fluid

maintained a moist environment at the wound surface, rehydrated dry necrotic eschar promoting autolytic debridement, degrading unwanted material and clearing the wound of dead cells (16,17).

Thus, this dressing provided an advanced alternative to gauze, which was unable to fulfil any of these functions.

As one of the first modern wound dressings and available for more than 20 years, these reliable and flexible dressings have undergone various modifications of the original formula. They have sustained their place in the practice of wound management by providing the optimal moist wound healing environment for a variety of wound types and shapes (18).

The effect of occlusive dressings on the biological processes of wound healing has been researched extensively through a variety of *in vitro*, animal and human studies. In the moist environment created by moisture-retentive dressings, cells are kept viable, enabling them to release growth factors and cytokines that contribute to the healing process (19). The moist, hypoxic environment created by moisture-retentive dressings is believed to accentuate angiogenesis (20,21), increases dermal fibroblasts thus promoting granulation tissue formation (22,23) and increases collagen synthesis (24).

Further experimental and human wound studies have identified differences that exist between acute and chronic wounds. Confirmation that wound fluid has constituents that facilitate or retard healing has been provided by several researchers (23,25–28). From their research, it is evident that there are a number of biological reasons for the use of dressings that maintain a moist environment and keep the wound fluid in contact with the wound surface.

The evidence that modern dressings are able to provide a better environment than gauze can be attributed to researchers of the last three decades. However, history reports that even in 1797, Thomas Baynton applied occlusive adhesive tape to venous ulcers finding that in comparison with those dressed with conventional gauze healing was faster (29).

PROVIDING EVIDENCE FOR CHANGE?

The introduction of moisture-retentive dressings should have facilitated a shift in practice away from the predominant use of gauze, but woven gauze still continues to be the most widely used product in wound care. In Japan, it has been reported that 44% of patients with chronic wounds are treated with gauze as opposed to 16% with moisture- retentive dressings (30).

In some instances, it can be argued that practitioners feel that moist wound healing is being achieved with the application of moistened saline gauze, as, if kept moist, it can be considered an effective wound dressing (31,32). In reality, none of the criteria of modern dressings are met, as the gauze is rarely kept moist and dries out on the wound becoming 'wet-to-dry' dressings (33).

In the United States (US), advocated as a method of debridement, the application of gauze as either 'wet-to-dry' or 'wet-to-moist' dressing is still widely practised (33–35). Allowed to dry on the wound bed, resulting in pain to the patient on removal, this method of wound debridement is also non-selective in the type of tissue removed.

Stotts *et al*. (36) in a survey of 240 nurses found that 19·8% were carrying out mechanical debridement using wet-to-dry dressings and 26·5% were using moist gauze as the primary dressing for wounds healing by secondary intention.

In the survey of Turner *et al.* (37), Home Health Care nurses also reported that the vast majority of dressings (89%) prescribed by doctors were wet-to-dry dressings.

More recently in a study of 1029 patients with 1638 classified wounds, Pieper *et al.* (38) found that 406 patients were treated with dry gauze and 145 with saline moistened gauze.

Numerous individual studies have highlighted deficiencies and problems related to gauze dressings in comparison with advantages achieved by modern wound dressings such as hydrocolloids (39). Shorter healing time (40–42) decreases in percentage ulcer size (43–45), dressing changes (45–48), staff time and transportation related to home visits (31,43,46,49) and hospital stay (48,50).

Additional meta-analysis of randomised controlled trials on hydrocolloids has also demonstrated clinical and statistical significance over gauze (51).

Recent systematic reviews (32,52) provide compelling evidence that a variety of moisture retentive products will provide benefits over gauze in relation to healing, pain and infection.

Key Points

- the introduction of moisture-retentive dressings should have facilitated a shift in practice away from the predominant use of gauze but woven gauze still continues to be the most widely used product in wound care
- recent systematic reviews provide compelling evidence that a variety of moisture-retentive products will provide benefits over gauze in relation to healing, pain and infection

Key Points

- heavily exuding wounds cannot be managed efficiently with gauze and provides limited protection against bacterial contamination
- partly due to the term 'occlusive', fears were expressed that film dressings and hydrocolloids would facilitate the multiplication of bacterial
- clinical studies found that removal of dry conventional dressings such as gauze from colonised wounds releases significantly greater numbers of bacteria into the air compared with occlusive dressings
- the performance of occlusive dressings in the clinical situation will always be affected by a variety of patient and environmental factors
- it is conceivable that the dressing may become the primary focus and seen as the cause of the wound infection
- this can detract practitioners from considering other factors that are more likely to be the cause of wound infection such as compromised circulation, or the presence of necrotic material

Woven gauze is prone to linting and shredding, especially when cut. If used to pack surgical wounds, then it can cause foreign body reactions in the form of granulomas or adhesions (2,53–56).

Heavily exuding wounds cannot be managed efficiently with gauze, as once saturated the wound becomes macerated and conventional absorbent cellulose dressings provides limited protection against bacterial contamination. If 'strike-through' is allowed to occur, then a pathway is provided for entry and exit of bacteria to and from the wound (57,58).

The production of the new occlusive hydrocolloid dressings in the 1980s would have increased the ability of practitioners to manage exudate from wounds, preventing these problems. However at the time, partly due to the term 'occlusive', fears were expressed that film dressings (5), and hydrocolloids, would facilitate the multiplication of bacteria. Even though during the following decade several researchers established hydrocolloid dressings were shown to provide an external barrier to bacterial and viral invasion (15,59–61), and that bacteria are as numerous under gauze dressings as under hydrocolloids (62), this subject is still debated.

Knowles *et al*. (63) in a retrospective review of the use of hydrocolloids for the diabetic foot found no increase in infection. Field and Kerstein (64) in a data review of controlled trials on a variety of wounds reported infection rates to be much lower in occlusive dressings. (7·1% for conventional dressings and 2·6% for occlusive dressings.) Boulton *et al*. (65) in a retrospective study of clinical outcomes over an 18-month period also reported 6% infections with the use of traditional gauze-type dressings as compared with only 2·5% infections with hydrocolloids. Other reviews (66,67) have also reported that hydrocolloids provide an optimal environment for the functioning of the normal defence mechanisms vital for the control of invading organisms.

Removal of dry conventional dressings, such as gauze from colonised wounds, releases significantly greater numbers of bacteria into the air as compared with occlusive dressings. It was reported some time ago in a review by Hutchinson and Lawrence (68) that airborne organism dispersal, transmitted on dressing removal, had the potential to increase hospital acquired infections especially where resistant organism are encountered. Lawrence's work (58,69) has contributed greatly to our understanding of airborne dispersal as in his 1994 study (58), he revealed air dispersed organisms to be 15 times greater in cellulose than occlusive dressings with organism counts remaining virtually unchanged 30 min after removal.

However strong research evidence may be anecdotal evidence will often influence choice. The performance of occlusive dressings in the clinical situation will always be affected by a variety of patient and environmental factors. The co-morbidities of the patient will influence host defences and microbial barrier may be compromised by excessive moisture from perspiration producing skin maceration and reduction of dressing adhesion. Patient movement may also cause the dressing to move or wrinkle allowing organisms passage to and from the wound site (70,71).

In such situations, it is conceivable that the dressing may become the primary focus and seen as the cause of a wound infection. This inevitably can detract practitioners from considering other factors that are more likely to be the cause of wound infection, such as compromised circulation, or the presence of necrotic material (72).

RESISTANCE TO CHANGE

Due to the inherent difficulties of conducting controlled wound dressing trials in this heterogeneous population, reviews have highlighted that despite good evidence many studies have design flaws with small sample sizes and variable outcome measures (32,52).

The variation in the performance of different dressings, and the complexity of different wound types, has in the past contributed to the difficulty in providing practitioners with conclusive evidence that any one dressing may be clinically or cost-effective over another.

Although there are many complex issues related to the continued use of gauze, in some countries, it is simply related to reimbursement of dressings and individual insurance cover. Whereas in theory the appropriate selection of dressings may be considered vital to the process of healing, in practice if the unit cost of a dressing is of prime concern, then the

wider issues of patient comfort, slower healing rates and staff time may not be considered. However as a gauze dressing requires frequent renewal, the cost argument needs to be questioned. The frequency with which gauze has to be changed relates not only to unit cost but also to skill, particularly in relation to gauze packing into small sinuses. Packing a wound with gauze takes greater dexterity, uses more equipment and nurse time and is unlikely to fill the wound space once the gauze has dried and shrunk.

Other reasons may be less financially driven or complex and can be explained as 'comfort' factors, that is, practitioners are accustomed to using gauze and have no reason to change. Whilst these 'comfort' factors apply to practitioner, it is doubtful they apply to the patient.

Conventional gauze dressings adhere to the wound bed, cause bleeding and tissue damage on dressing removal and expose the patient to unnecessary pain (73–78).

From their initial introduction, hydrocolloids were, and still are, designed to be left in place for several days. On removal, they have been found not to stick to wounds, causing less trauma to the newly formed tissues (45,63,79) as in the case of gauze. They have also been reported to provide local pain relief to the wound area which is thought to be due to protection of the nerve endings (40,80,81). Newer formulations of CMC dressings used as packing material have been shown to have numerous positive benefits for the patient resulting in less pain on application and removal and decreased use of analgesia (48,50).

But whilst practitioners prefer to maintain the belief that there is a lack of concrete evidence for any one particular dressing, there is a substantial body of evidence against the use of gauze. However, the view that gauze is as efficacious and clinically effective as the perceived more expensive modern materials appears to continue (82).

Although there are various theories regarding why people change or alter their behaviour, the acquisition of knowledge can give people the power to change and is the tool that can be used for modifying patterns of practice and facilitate institutional change (83).

It may be therefore argued that the resistance to change by practitioners from gauze to modern products was and continues to be, based on their lack of knowledge, relating to product development and the principles that underpin moist wound healing.

Studies of the role of the nurse in wound care have revealed that decisions are often influenced, not by professional factors such as knowledge, or use of research findings, but by interpersonal factors such as lack of assertiveness and relationships with doctors or other nurses in the team.

Although a specialist nurse may advocate the use of modern dressings, they may not always be in a position to apply the primary wound dressing. Surgeons traditionally have made the initial choice of dressings at the end of surgery (84) with many still opting for gauze due to low unit cost and personal preference. In Flanagan's (85) and Harker's (86) studies, specialist nurses described that frequent conflict regarding dressing choice was most likely to be evident in surgical areas. However such conflict was less likely to occur with physicians, as nurses tended to have closer relationships with their medical colleagues.

Where doctors were prescribing dressings, nurses in both Flanagan and Harker's work described feeling under pressure to conform and often found it easier to give in and use treatment they disagreed with to maintain the ward equilibrium.

In countries such as US, Germany and Japan although it is the doctor who prescribes the dressing, the mode of application or removal may not be performed as prescribed. In the study of Turner *et al.* (37), it was observed that although wet-to–dry gauze dressings were prescribed, on removal they were frequently moistened by nurses even though they had been instructed to remove them dry to facilitate mechanical debridement.

This apparent refusal by nurses to follow the doctor's instructions is not unique to wound care and is traditionally referred to as the 'doctor–nurse game' (87). It is where the doctor believes that their instructions are carried out to the letter, but in reality the nurse does what they believe is best practice and best for the patient.

This of course does little to change medical practice as it only serves to reinforce the belief that treatment with gauze is successful.

CONCLUSION

The reasons for the continued use of gauze are undoubtedly complex and cannot be merely

Key Points

- whereas in theory the appropriate selection of dressings may be considered vital to the process of healing, in practice if the unit cost of dressing is of prime concern, then the wider issues of patient comfort, slower healing rates and staff time may not be considered
- other reasons may be explained as 'comfort' factors, that is, practitioners are accustomed to using gauze and have no reason to change
- the resistance to change to modern products was, and continues to be, based on their lack of knowledge relating to product development and the principles that underpin moist wound healing
- studies of the role of the nurse in wound care have revealed that decisions are often influenced, not by professional factors but by interpersonal factors
- although a specialist nurse may advocate the use of modern dressings, they may not always be in a position to apply the primary wound dressing
- in countries such as the USA, Germany and Japan, although it is the doctor who prescribes the dressing, the mode of application or removal by the nurse may not be performed as prescribed
- the 'doctor-nurse game' does little to change medical practice as it only serves to reinforce the belief that treatment with gauze is successful

Key Points

- the ability to change practice may be hindered by lack of sufficient knowledge about the way in which individual dressings work especially with the large variation in modern dressing products that exist today
- in some cases, the organisation in which they work prevent the knowledgeable specialists from asserting their authority over care
- in conclusion, whatever the underlying cause, it is hard to imagine such ritualistic and outdated practices would exist in any other area of healthcare

related to unit cost or the perceived paucity of clinical evidence.

Undoubtedly education plays a significant part in informing practitioners, but one must consider that within the current demands of health service delivery and the increasing amount of clinical evidence practitioners have to read, wound care is often placed low on the list of competing priorities.

The ability to change practice therefore may be hindered by a lack of sufficient knowledge about the way in which individual dressings work especially with the large variation in modern dressing products that exist today. Terminology such as occlusive, non-occlusive, semi-permeable and moisture-retentive dressings may be confusing to the non-specialist who, in the majority of healthcare settings, will be the major care giver.

If, such terms imply to those with limited experience and/or time, dressings that retain sufficient moisture at the wound bed and maintain a moist environment, then the application of wet-to-moist dressings may be considered by some, an acceptable dressing.

In some cases, informed decisions on dressing choice are made by the knowledgeable specialists, but the organisation in which they work prevent them from asserting their authority over care.

Whatever the underlying cause, with the amount of research that has been performed and published since the concept of moist wound healing was introduced, it is hard to imagine that such ritualistic and outdated practices would exist in any other area of healthcare.

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