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THE USE OF WET-TO-DRY DRESSINGS FOR MECHANICAL DEBRIDEMENT

by

Katherine Villa

A thesis submitted in partial fulfillment of the requirements
for the Honors in the Major Program in Nursing
in the College of Nursing
and in The Burnett Honors College
at the University of Central Florida
Orlando, FL

Spring Term 2013

Thesis Chair: Dr. Maureen Covelli

Abstract

Clinical management of complex wounds is essential to promote wound healing. Prolonged healing time may lead to longer and more costly hospitalizations and poorer patient outcomes. The removal of nonviable, necrotic tissue via debridement is vital to the healing process. One of the most common debridement techniques, in the United States, is the use of wet-to-dry dressings. There are no defined guidelines or protocols for the timing of dressing changes and subsequent debridement. The purpose of this study was to perform a review of literature to determine the rationale for the use of wet-to-dry dressings, explore alternative time sequences of treatment, and to identify the risks and benefits for this methodology of debridement in an adult population with acute traumas. Inclusion criteria consisted of peer reviewed, English Language, research articles published within the last 5 years (2007-2012), adults with acute wounds treated by wet-to-dry dressing debridement. This review of literature was conducted using CINAHL and MEDLINE databases using the following search terms: Wound debridement, wet-to-dry dressing*, timing, sequencing, schedul*, standard*, debridement, acute wound*, and mechanical debridement.

The review of literature yielded zero results meeting the search criteria therefore, a second review of literature was performed using the same search criteria but expanded to include articles published within the past 15 years (1997 -2012). The second review of literature also yielded zero results that met the search criteria. A lack of evidence supporting the use of wet-to-dry dressings for the purpose of debridement suggests that healthcare providers are following tradition rather than evidence based practices. Nurses and healthcare providers need education on best practices in wound care to advocate for their patients to ensure the best possible outcome. Further research on wound care modalities that are clinically efficient is needed.

Dedication

To my husband, Kevin, I'm so blessed to have you in my life. Thank you for your love and support, you are my rock throughout this crazy thing called nursing school. I love you more and more each day and look forward to what the future holds for us.

To my family, Mom you have always been my number one cheerleader, you've taught me unconditional love and are an amazing, strong woman, I'm so lucky to have you. Kelly (aka mini me) I love you and am so proud of the young woman you have become. To my brothers, John Michael and Joel, thank you for your support and encouragement even through hard times, through thick and thin we are family that's a bond that can't be broken. Jim, thank you for helping me attain my dream, without your love and support this wouldn't have been possible. To my grandparents, thank you for all of your love and prayers, I know that it has gotten me through hard times.

To my Cuban familia, the Villas, thank you for your continued encouragement. You have given me the greatest gift in life, my soul mate. Thank you for raising such an amazing man, I love you all and I'm proud to be a Villa.

To my Aunt Linda, not a day goes by that I don't think about you, your positive outlook on life is something that I strive for each and every day. I miss you more than words could ever express, I love you me mo mo

To Stephanie and Ashley, I couldn't imagine going through nursing school without you. You've both been there every step of the way and I truly thank you for your love and support.

Acknowledgments

To the members of my committee: Dr. Maureen Covelli, Dr. Linda Howe, and Dr. William Hanney, thank you for your guidance and support throughout this endeavor. Dr. Covelli, thank you for trusting in my vision and being my mentor this past year. Thank you for guiding me through this journey and helping focus my ideas, I appreciate everything you have done for me. Dr. Howe, thank you for your words of encouragement, I am honored to be one of your “national treasures.” Dr. Hanney, thank you for being a part of my committee and providing valuable insight each step of the way.

I would like to thank all of the faculty and staff from the College of Nursing for the opportunities presented to us for our continued education in the field of nursing. UCF has pushed me to limits I didn’t think were possible. I am proud to be graduating as a Knight; we bleed black and gold for life.

I would like to thank the University of Central Florida for the resources used in this thesis, and a special thanks to Mrs. Elizabeth Killingsworth, an amazing research librarian for all of her help.

I would like to thank the Burnett Honors College for their guidance through the research process and for the opportunity to participate in the Honors in the Major Program.

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Introduction

The Center for Disease Control and Prevention (2010) estimates that surgical site incisions (SSIs) become infected in every 1 to 3 persons of 100 who undergo surgery due to break in sterile field and/or improper wound closure and treatment. According to Scott (2009), SSIs are the most costly hospital associated infections (HAI) to treat. The incidence of SSIs is approximately 300,000 a year ranging from $11,000 to $30,000 debt accrued by the hospital for each case (Scott, 2009). The use of evidence based practice in the care of wounds may allow healthcare agencies to reduce the number of HAIs thus reducing the financial burden of nearly $10 billion a year paid by US hospitals (Scott, 2009).

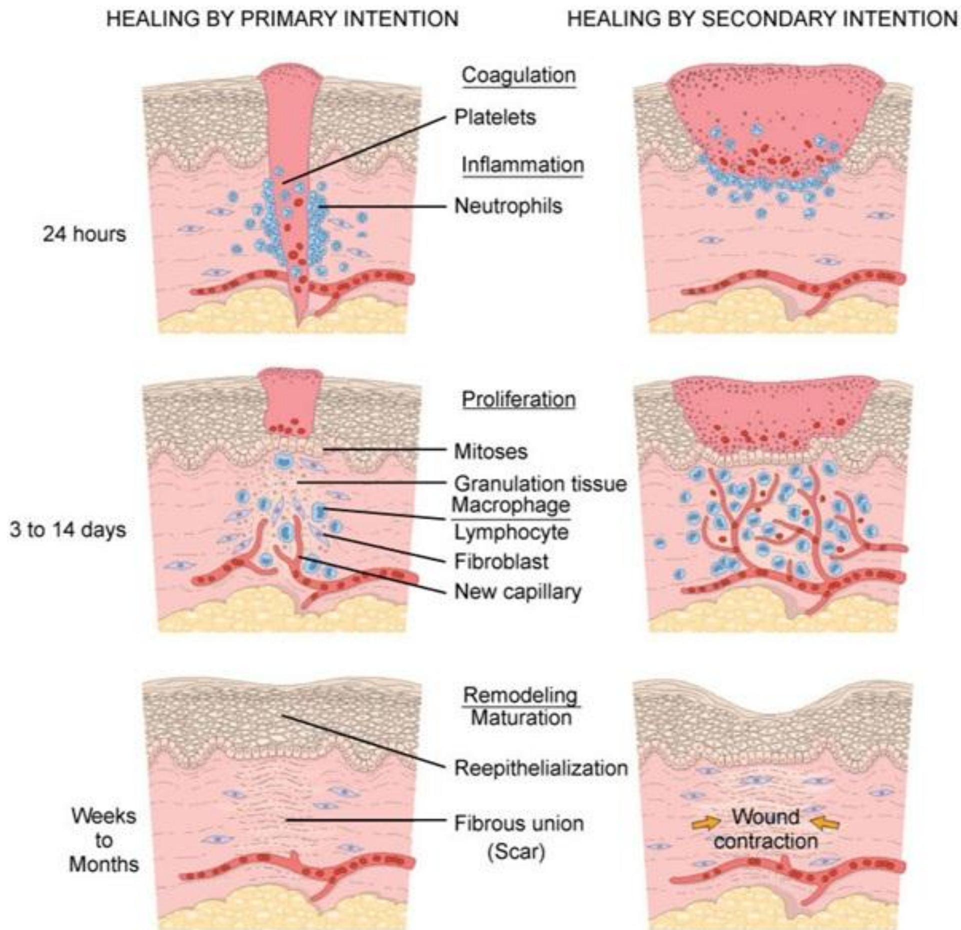
In complex wounds, clinical management is essential to promote an optimal wound healing environment. Wound healing is initiated by the inflammatory response in to limit infection and prevent further damage. If the inflammatory response is hindered, wound healing is prolonged leading to longer hospitalizations, increased costs, and poorer patient outcomes including increased risk for infection. Open wounds that are not efficiently treated may lead to chronic inflammation thereby complicating the site further by decreasing viable tissue due to reduced tissue perfusion. Necrotic tissue provides an ideal environment for bacteria growth and without clinical intervention the patient will be at high risk for infection. Patient safety, the return to optimal health, and infection prevention are primary goals both clinically and financially of wound management.

Types of wounds

Wounds have multiple causes – accidental (trauma, burns, infection, lacerations), intentional/surgical, or chronic origins (venous or diabetic foot ulcers). Wounds heal by either primary or secondary intention depending on what caused the injury (Figure 1). Injuries healed by primary intention have well approximated edges, small amounts of tissue loss, with little scarring, and minimal contraction or shrinkage. These types of wounds are usually surgical or traumatic and are considered to be acute as they heal within a normal time frame (Rote, 2012). Wounds that heal by secondary intention have large amounts of tissue loss with wide and irregular borders that heal from the bottom up leaving more granulated tissue; infection, and ulcerations such as diabetic, venous, and pressure ulcers usually heal by secondary intention (Zaiontz & Lewis, 2011). Ulceration wounds are considered to be chronic as they have a prolonged inflammation process of more than two weeks (Braun & Anderson, 2011).

Phases of wound healing

Wound healing can be divided into three phases: inflammation, proliferation, and remodeling (Figure 1). Inflammation begins immediately after an injury and usually lasts 24 to 48 hours. Initially, the clotting cascade is activated and a fibrin mesh is formed which traps platelets creating a thrombus; therefore, stopping the bleeding and preventing the passage of other pathogens (Figure 2) (Rote, 2012). Platelets release inflammatory mediators such as serotonin and histamine, leading to vasodilation and increased vascular permeability respectively. This allows neutrophils and macrophages to squeeze through the vessels and infiltrate the site of injury. Neutrophils are the first responders responsible for clearing the wound of bacteria and debris (Braun & Anderson, 2011). Macrophages are phagocytes that continue to clear the wound of debris, release growth factors and mediators to aid in the formation of new tissue, and attract immature connective tissue cells known as fibroblasts for angiogenesis (Rote, 2012).

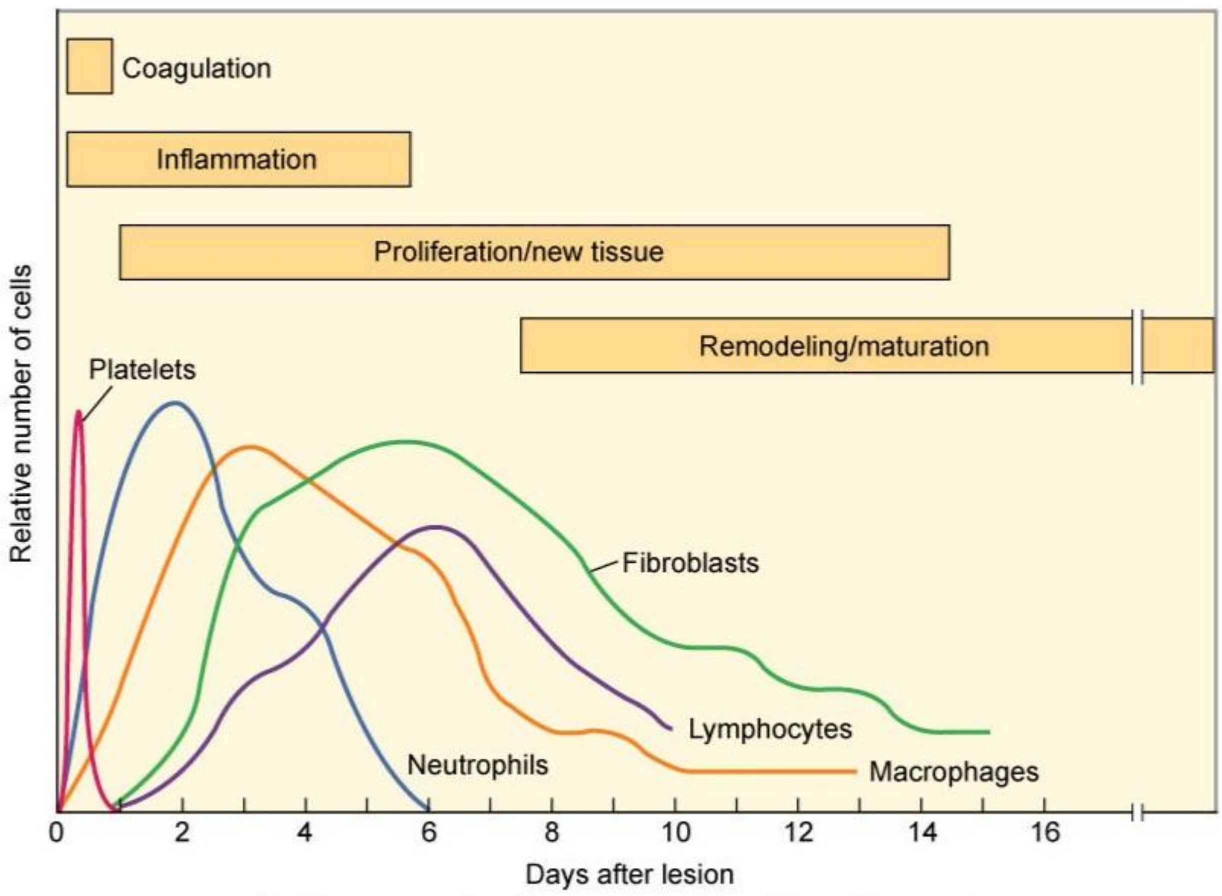


(From Roberts JR, Hedges J: *Clinical procedures in emergency medicine*. Ed 5, Philadelphia, 2009, Saunders.)

Figure 1. Phases of wound healing by primary and secondary intention 1) Inflammation and coagulation, 2)Proliferation, and 3)Remodeling and maturation phase. Secondary intention wounds have more granulating tissue and contraction then primary intention.

Proliferation the second phase of wound healing, can last from 3 days to 2 weeks depending upon the type of wound present. During this time, fibroblasts are signaled to the site of injury via mediators secreted by macrophages. There are multiple mediators secreted by macrophages during proliferation that are transforming growth factor-beta (TGF-β), angiogenesis factors, and matrix metalloproteinases (MMPs). TGF-β produces and secretes collagen that is important for tissue granulation while angiogenesis factors imitate capillary formation, and MMPs remodel proteins to provide stretch and reduce the formation of scar tissue. New tissues are pink in color with granules (the beginning of capillaries) that begin to grow into the wound from surrounding connective tissue, hence the name “tissue granulation” (Rote, 2012).

The final stage of tissue repair is remodeling and maturation that can span anywhere from 2 weeks to 2 years. This phase is characterized by further cellular differentiation, fibrotic formation, and scar remodeling (Rote, 2012). Reepithelialization continues, scars begin to contract, and fibroblasts begin to disappear which will both increase the strength of the formed tissue and cause avascularization (Rote, 2012; Zaiontz & Lewis, 2011). In situations where the wounds overwhelm the normal inflammatory process, clinical interventions are needed to facilitate the healing process.



(From Townsend CM et al, editors: *Satiston textbook of surgery*, ed 18, St Louis, 2007, Elsevier.)

Figure 2. Cellular Level of the different phases of wound healing. Coagulation and inflammation occur within the same time frame with the increase of platelets, and neutrophils followed by macrophages. Inflammation and proliferation are occuring at the same time; new tissue is being formed via signals sent by growth factors and mediators released by platelets and macrophages. Fibroblasts are recruited by macrophages to begin the granulation process and lymphocytes are last to arrive.

Management of wounds: debridement

Management of wound healing is complex and multifactorial. Dead tissue hinders the wound's ability to granulate, form blood vessels, and normal tissue matrices all necessary for the healing process. "Necrotic burden" is damaged or dead tissue, and increased exudates or bacteria on the surface of the wound that may impede wound healing. Devitalized tissues such as eschar and slough provide nutrients for bacteria to survive and breed. The presence of bacteria signals the body's innate inflammatory response to release an excess of cytokines that has been implicated in prolonged wound healing (Spear, 2010). By removing the "necrotic burden", it reduces the likeliness of infection and prolonged wound healing (Stryja, 2012).

Debridement is the process of removing non-viable tissue and foreign material from the wound bed; it is considered an essential part of the healing process (Young, 2011). Debridement may be used in patients who have suffered burns, resistant bacterial infections, pressure ulcers, infected surgical incisions and wound dehiscence as a means to prepare the wound bed for healing (Smith, Dryburgh, Donaldson, & Mitchell, 2011; Young, 2010) .

A multitude of methods are utilized for wound debridement. The most appropriate method for the patient is dependent upon a thorough assessment based on the size, type of wound, location, the amount of tissue to be removed, the condition of the wound, client autonomy, time needed for debridement, patient's pain tolerance, healthcare setting, availability of resources (including materials, capital, and time), and clinician's knowledge (Young, 2011). The patient's background and comorbidities such as diabetes, hypertension and anemia must be taken into account as they may affect blood flow to the wound. Areas of poor vascularization may be contraindicated for wound debridement until normal blood flow can be returned (Spear, 2010). Other factors that have been implicated in prolonged wound healing include: advanced age, obesity, smoking, corticosteroid regimens, infection, and nutritional deficiencies (Zaiontz, & Lewis, 2011).

Debridement techniques

Different techniques for wound debridement include surgical or sharp, biological, autolytic, mechanical, chemical and enzymatic (Smith et al, 2011). Surgical debridement is a quick, aggressive technique preformed by a surgeon on an area with large amounts of necrotic burden under general anesthesia (Zaiontz, & Lewis, 2011). Sharp debridement removes less tissue and is performed by the health care provider; local anesthesia is sometimes used to numb area around the tissue to be removed if excision is deep or patient is in pain (Spear, 2010). Instruments used in both surgical and sharp debridement include scalpels, scissors, electro-cautery tools, hydrosurgery devices, and lasers (Stryja, 2012; Spear, 2010).

Biotherapy involves the use of maggots to ingest and digest necrotic tissue and bacteria without harming healthy tissue. Medical maggots have been used more frequently since 2004 when the US Food and Drug Administration (FDA) approved them as a means for wound debridement (Opletalova et al, 2012). The use of maggots is also used to combat some forms of chronic antibiotic resistant bacteria (Spear, 2010). Honey is another alternative agent approved by the FDA (2007) for debridement. Honey has a strong osmotic pull when placed on the surface of the wound. This causes lymphatic fluid to enter from the base of the wound adding moisture to remove non-viable tissue with minimal pain (Pieper, 2009).

Autolytic debridement uses the body’s own phagocytes and proteases to break down necrotic tissues (Smith et al, 2011). This is accomplished through the application of occlusive and semi-occlusive dressings with the use of topical ointments to keep the wound bed moist and hydrated, softening eschar and slough, allowing for natural removal of debris (Zaiontz, & Lewis, 2011). Autolytic debridement is slower but relatively painless compared to other types of debridement (Spear, 2010).

Enzymatic debridement uses topical exogenous enzymes derived from bacteria and shellfish that work with a patient’s natural enzymes to breakdown and digest non-viable tissues (Smith, 2011; Young, 2011). Some enzymes used include collagenase, papain, and urea; however, only collagenase is approved for debridement by the FDA (Zaiontz, & Lewis, 2011; Spear, 2010). These proteins target and break apart the collagen filaments found in the necrotic tissue and subsequent debridement (Spear, 2010). Agents are applied topically and then covered with moist dressings requiring frequent dressing changes (Zaiontz, & Lewis, 2011).

Chemical debridement remains somewhat controversial; abrasive agents such as hypochlorites, and hydrogen peroxide are used for this technique. According to Smith et al (2011), more research is needed to determine whether the benefits outweigh the risks of using these chemicals, which have been shown to breakdown both necrotic and healing tissues.

Mechanical debridement is a "nonselective method" that physically removes devitalized tissue from the wound bed (Smith et al, 2011). There are three different techniques used in mechanical debridement: wet to dry dressings, whirlpool therapy, and wound irrigations (Zaiontz, & Lewis, 2011). Whirlpool therapy submerges the patient in a whirlpool bath and the action of the water moving across the wound creates a light friction to loosen and moisten necrotic tissue for removal (Smith et al, 2011). Whirlpool therapy is recommended for persons who have minimal tissue to be removed and should never be used in patients with clean granulating wounds (Zaiontz, & Lewis, 2011). Wound irrigation uses an intermittent or continuous high pressure stream of fluid (usually normal saline) to remove necrotic burden from the wound bed (Smith et al, 2011). Research has suggested that the forceful flow of fluid has driven bacteria further into the wound and is more detrimental than helpful (Spear, 2010).

Wet-to-dry dressings are the most commonly used method for debridement in healthcare facilities. Proper application of wet-to-dry dressings begins with assessing the wound and cleaning the outside surface with normal saline. After it is cleaned, cotton gauze is soaked in a solution and lightly packed into the wound bed. Devitalized tissue will adhere to the dressing while it dries; once it is dried, the dressing is removed and subsequently the necrotic tissue (Cowan, & Stechmiller, 2009). This method is repeated until all of the non-viable tissue is removed (Smith et al, 2011). This type of debridement is a collaborative process; the physician or appropriated health care professional prescribes the wet-to-dry dressing protocol. Professional nurses and in more complex cases, advanced practice nurses and certified specialty nurses (wound care and ostomy nurses) implement the procedure and evaluate the outcomes. This study will focus specifically on wet-to-dry dressing debridement as there is inconsistency in practice, protocols, and guidelines.

Problem

Wet-to-dry dressings are the most commonly prescribed method of debridement in healthcare facilities (Cowan, & Stechmiller, 2009). However, there are no set guidelines for the timing of dressing changes and subsequent debridement. Patients may have different rates of wound healing depending upon factors such as age, weight, comorbidities and diet (Zaiontz, & Lewis, 2011). The usual protocol for dressing changes is 1 to 4 times a day, based upon provider preference regardless of the patient's healing profile using limited evidenced based rationale (Dale, 2011; Kirshen, Woo, Ayello, & Sibbald, 2006).

Purpose

The purpose of this study is to determine the rationale for the use of wet-to-dry dressings, explore alternative time sequences of treatment, and identify risks and benefits for this methodology of debridement in an adult population with acute traumas.

Method

A review of literature related to wound healing physiology and current wet-to-dry dressing practices was conducted. Information was utilized from Cumulative Index to Nursing and Allied Health Literature, and MEDLINE databases to determine current wet-to-dry dressing practices, explore the rationale for time sequencing, and the risks and benefits for this debridement. Inclusion criteria consisted of peer reviewed articles published within the last 5 years (2007-2012), adults with acute wounds being treated using wet-to-dry dressing debridement, and written or translated in English language. Current nursing text books that were peer edited and printed within the last 5 years in the English language were used to determine physiology of wound healing.

Search Terms Utilized

The following search terms were used for the literature review: first search terms included wound debridement, debridement, wet to dry dressing*, and mechanical debridement. If the results yielded over 500 articles, a second search terms was used. Second search terms included wet to dry dressing*, timing, sequencing, schedul*, standard*, and acute wound*.

Table 1. Search terms utilized during review of literature with a 5 year publication filter

First Search Term	Second Search Term	Articles Yielded	Articles Meeting Search Criteria
Wound debridement		884	
	Wet to dry dressing*	6	0
	Timing	19	0
	Sequencing	1	0
	Schedul*	3	0
	Standard*	99	0
Debridement		2085	
	Wet to dry dressing*	6	0
	Acute wound*	41	0
Mechanical debridement		72	0
Wet to dry dressing*		11	0

The initial review of literature yielded zero results; so a second review was performed that utilized the same search criteria but expanded to include articles published within the past 15 years rather than five. Increasing the search parameters to include articles within the past 15 years would increase the likeliness for other publications to meet the search criteria.

Table 2. Search terms utilized during review of literature with a 15 year publication filter

First Search Term	Second Search Term	Articles Yielded	Articles Meeting Search Criteria
Wound debridement		1905	
	Wet to dry dressing*	18	0
	Timing	27	0
	Sequencing	1	0
	Schedul*	4	0
	Standard*	206	0
Debridement		3960	
	Wet to dry dressing*	18	0
	Acute wound*	78	0
Mechanical debridement		127	0
Wet to dry dressing*		43	0

Findings

Initial review of literature

An initial review of literature was conducted using articles published within the last 5 years. Using the first search term of wound debridement 884 articles were yielded; since over 500 articles were found, a second search term was used in order to narrow down the results. Wound debridement and wet to dry dressing* produced 6 results, 0 were useable as they were reviews of literature. Wound debridement and timing yielded 19, however 0 fit the inclusion criteria since they were all surgical debridement and not mechanical using wet to dry dressings. Wound debridement and sequencing gave 1 result that was not used as it pertained to chronic diabetic ulcer wounds rather than acute wounds. Wound debridement and schedul* yielded 3 results, 0 fit the search criteria; 1 was focused on surgical debridement rather than wet to dry mechanical debridement, 1 used hydrotherapy, and the other article was eliminated because it was a chronic wound rather than acute. Wound debridement and standard* produced 99 results that were not used because they did not fit the inclusion criteria.

Debridement as a first search term yielded 2085 results, so a second search term was utilized. Debridement and wet to dry dressing* produced 6 articles none of which fit search criteria. Debridement and acute wounds yielded 41 publications, 0 fit search criteria.

The search term “mechanical debridement” yielded 72 articles, 1 related to wet to dry dressing debridement but was not utilized as it was a review of literature. “Wet to dry dressing*” produced 11 articles, 0 met search criteria.

Second review of literature

Since the initial review of literature yielded zero articles after applying search criteria, a second review was performed using the same search terms and parameters except for expanding the date of publication to fifteen years instead of five years. The first search term “wound debridement” yielded

1905 results so a second search term was again used. Wound debridement and wet to dry dressing* produced 18 results, 0 met search criteria. Wound debridement and timing yielded 27 results none met the search criteria. Wound debridement and sequencing resulted in 1 article that was not used as it pertained to surgical debridement. Wound debridement and schedul* yielded 4 results, but none fit search criteria. Wound debridement and standard* produced 206 results, 0 met the inclusion criteria.

Debridement was then used as a first search term that yielded 3960 articles. Since more than 500 articles were found a second search term was applied. Debridement and wet to dry dressing* yielded 18 results, none met the search criteria. Debridement and acute wounds produced 78 results, 0 met the inclusion criteria. "Mechanical debridement" was another first search term used that yielded 127 articles, 0 were utilized as they did not fit search criteria. The last search term used was "wet to dry dressing*" that yielded 43 results, 0 were useable as they did not meet inclusion criteria. Due to the extremely scarcity of articles related to specified criteria, additional related articles were reviewed; two pertaining to acute and chronic wounds were added.

Original Studies

Armstrong and Price

A descriptive study by Armstrong and Price (2004), was designed to identify the practice of wet-to-dry dressings among surgeons, interpretation of wet-to-dry practices from a clinical perspective, and barriers of using modern dressings. A questionnaire was mailed to a convenience sample of 127 out of 190 general surgeons registered with New Hampshire or Vermont state medical boards; 65 surgeons responded. A questionnaire developed by the authors, contained 8 hypothetical wounds healing by secondary intention situations. The objective was to identify the type of dressings surgeons prescribe to determine the frequency of wet-to-dry orders compared to other alternatives. Surgeons were asked to choose the most appropriate dressing (wet-to-dry, alginate, gel, foam, or hydrocolloid) for each wound presented. Of the 65 surgeons, 32 used only wet-to-dry dressings on each of the 8 wounds; 30 of the 65 surgeons chose wet-to-dry dressings for use of the surgical wound. Armstrong and Price (2004) concluded that wet-to-dry dressings were being prescribed inappropriately as the surgical wound presented was not in need of debridement.

The study suggests a disparity between provider orders and clinical practice. Armstrong and Price (2004) interviewed 9 wound care and ostomy nurses from different healthcare settings (specifics about organizations and where nurses practiced was not disclosed) to compare clinical practice with provider orders, and to gain perspective on US debridement practices using wet-to-dry dressings. The 9 nurses were asked how they preformed wet-to-dry gauze changes; 6 of the 9 nurses followed wet-to-dry practices for debridement allowing the gauze to fully dry before removal, 1 used moist-to-moist, 1 rarely used gauze dressings, and 1 used wet-to-dry dressings on the majority of wounds when debridement was not indicated. If debridement was not required, the majority of nurses admitted to moistening the dressing therefore amending the order from wet-to-dry to wet-to-moist dressings. The small sample of nurses, undisclosed location and affiliations, and lack of method for determining the key informants can be considered a limitation to this study (Armstrong, & Price, 2004).

Barriers of surgeons for prescribing alternative forms of occlusive dressings were determined. Armstrong and Price (2004), included questions about access to alternative occlusive dressings, cost of gauze versus other dressings, education of different occlusive dressings, and which dressings they were most comfortable ordering. Prescribers' reasoning for using wet-to-dry gauze as dressings for wounds was based on familiarity, simplicity, tradition, cost, and lack of education on modern dressings. Availability of alternative products was not a factor when choosing an appropriate intervention as 49 of the 65 surgeons had access to alternative dressing modalities (Armstrong, & Price, 2004).

Cowan and Stechmiller

Cowan and Stechmiller (2009) conducted a descriptive retrospective review of 202 persons with open wounds (both acute and chronic) healing by secondary intention. The purpose of this study was to assess the frequency of wet-to-dry dressing orders compared to other modalities, which healthcare specialties utilize this method most often, and to investigate if wet-to-dry dressings are appropriately prescribed. Subjects were randomly selected from a health maintenance organization (HMO) and a home health agency in Florida. Chart reviews were conducted by the authors, to determine the preferred wound dressing, the frequency of use of wet-to-dry versus other dressings, the healthcare providers prescribing wet-to-dry dressings, types of wounds, average amount of viable tissue present, and if mechanical debridement was indicated base upon the amount of nonviable tissue present in the wound bed.

Results indicated that healthcare providers prescribed wet-to-dry dressings for the majority of open wounds healing by secondary intention; 42% of both full and partial thickness wounds were treated using wet-to-dry dressings. The chi-squared test of significant was utilized to demonstrate differences among groups. There was a significant difference between treatment of full and partial thickness wounds. Full thickness wounds were more likely treated with wet-to-dry dressings than partial thickness ($p=0.01$). Surgeons prescribed wet-to-dry gauze most often; approximately 55% of orders for this method are prescribed by general surgeons. There was a significant difference of health care providers prescribing wet-to-dry dressings. Surgeons were most likely to prescribe this method ($p=0.01$). Literature reviews conducted by Cowan and Stechmiller (2004) suggested if more than 50% of granulating tissue is present in a wound bed than wet-to-dry debridement is not indicated; $p = 0.11$ (meaningful but not significant) the use of wet-to-dry dressings and subsequent debridement was not appropriate for most wounds. This study determined that 82% of wet-to-dry dressings were inappropriately ordered based upon the amount of granulating tissue present in the wound bed. A limitation to this study is that wounds with 76 – 99% granulating tissue and 100% granulating tissue of wound beds were analyzed as 2 separate groups; for this reason, no significant difference was confirmed. The misappropriated utilization of wet-to-dry dressings demonstrates a lack of evidence based practice (Cowan, & Stechmiller, 2009).

Other Articles Utilized

Eight peer reviewed articles on mechanical debridement using wet-to-dry dressings were analyzed to determine risks and benefits for this modality, rationale behind using wet-to-dry dressings and to explore alternative methods of debridement for adults with acute wound processes.

Ovington's (2002) review of literature that examined the difference between wet-to-dry and wet-to-moist gauze, and patient, clinician, and healthcare issues with the use of this technique. Wet-to-dry dressings are intended for debridement. It is a nonselective process for the removal of necrotic tissue from the wound bed. This process may cause reinjury to the site, removal of healthy tissue, and is painful upon removal of the dressing. Ovington states that wet-to-moist gauze is essentially the same process, but it is to be removal while still moist. However, if the dressing changes are not practiced in a timely manner, the gauze will dry and ultimately cause subsequent debridement (Ovington,2002).

Ovington's review of literature included patient issue of prolonged healing due to local tissue cooling, pain, and increased risk of infection. Thomas (1990) was cited that discussed how the use of wet-to-dry dressings decreases the temperature of a wound bed to 25° - 27° C approximately 10° below normal tissue temperatures due to evaporation of fluid from the wound. The impedance of wound healing related to the cooling effect on tissues is related to the vasoconstriction that occurs causing hypoxic tissues, decreased leukocyte and phagocyte mobility, all of which increase a person's risk for infection. Infection is another patient issue; not only does wound healing place the patient at an increased risk for infection but the use of gauze alone does. A study conducted by Lawrence (1994), demonstrated that bacteria were able to penetrate 64 layers of dry gauze essentially leaving the wound exposed to outside pathogens.

Ovington's review of literature discusses clinician and caregiver issues including labor and the risk of airborne bacteria leading to cross contamination. Wet-to-dry dressings are changed up to 4 times a day and depending on the wound can take hours to complete. The role of dry gauze causing cross contamination was explored in research; dry gauze caused bacteria to be airborne for 30 minutes after removal occurred which Ovington argued could cause cross contamination (Lawrence, Lilly, & Kidson, 1992). Financial constraints were discussed as a "healthcare systems issue."

Three studies were referenced (Cowell, Foreman, & Trotter, 1993; Xakellis, & Chrischilles, 1992; Bolton, van Rijswijk, & Shaffer, 1997) that supported other dressing modalities that can be utilized for debridement and were more cost effective than gauze once all direct (supplies, labor, ect) and indirect cost were accounted for. Ovington referenced Colwell, Foreman, and Trotter's (1993) randomized controlled trial comparing the cost and clinical efficiency of using gauze versus semiocclusive dressings (DuoDerm a hydrocolloid wafer dressing) on 70 patients with 97 pressure ulcers stages II or III. The hydrocolloid dressing had better clinical outcomes (11 patients healing) compared to the use of moist gauze (1 patient healed). The hydrocolloid dressing ($6.15) had a higher ancillary price than gauze ($0.47), however, after factors such as time and labor were factored in, hydrocolloid dressings were found to be more cost effective than gauze, ($3.55 versus $12.26 respectfully) due to frequent dressing changes of gauze (Colwell et al, 1993; Ovington, 2002).

Xakellis, and Chrischilles (1992), conducted a randomized controlled trial comparing the use of hydrocolloid dressings versus wet-to-moist dressings for the treatment of decubiti in a long term care facility over a period of 21 months. Thirty-nine clients participated in the study and were randomly selected to one of the two treatment groups. Xakellis and Chrischilles determined that 89% of patients being treated with hydrocolloids were treated with a median healing time of 9 days whereas 86% of clients were treated using wet-to-moist gauze with a median healing time of 11 days; no significant difference was found (p=0.12). A price comparison between the two modalities found hydrocolloid dressings ($15.90) to be more cost efficient than gauze ($25.31) after time, labor, and supplies were factored in. Nursing care utilizing hydrocolloid dressings was one-eighth that of gauze due to less frequent dressing changes, therefore, reducing cost of labor (Xakellis, & Chrischilles, 1992; Ovington, 2002).

Bolton, van Rijswijk, and Shaffer (1997) proposed patient outcomes as being a variable in the cost of care arguing that if an inexpensive product is not clinically efficient then capital is being wasted. The study suggests that alternatives to gauze dressings are more feasible to healthcare systems today as they reduce the length of hospitalization, are associated with a decreased risk of infection, and less painful therefore decreasing expenses and increasing patient satisfaction (Bolton et al., 1997).

A literature review by Spear (2008), evaluated evidence for the use of wet-to-dry dressings and compares its use to moist wound healing. The study presents a historical perspective on the use of wet-to-dry dressings from ancient times up to Winter's (1962) study that questioned the use of this modality. Spear conducted a review of literature in PubMed using the search phrase "wound care" that yielded 58,815 results including randomized clinical trials, case reports, comparative trials, and literature reviews. Spear states, "much of this literature emphasized moist wound healing" (p. 93). Disadvantages such as pain, cost, labor, increased risk of infection, tissue cooling, and cross contamination were reviewed citing Thomas (1990) and Lawrence (1994). Spears cited Armstrong and Price (2004) and Ovington (2002) when indentifying possible reasons for the continued use of wet-to-dry dressings that included tradition, lack of education and cost.

Spear (2010), discusses necrotic burden and the necessity of debridement to prepare the wound bed for the healing. Wet-to-dry dressings were discouraged as a painful process that leads to decreased blood flow and are neither financial nor clinically effective. Spear briefly discusses methods of debridement (autolytic, enzymatic, biotherapy, and sharp) and the advantages and disadvantages for each.

Kirshen et al (2006) describes the necessity of debridement for wound bed preparation. Best practices include identifying and treating the cause, addressing patient concerns, providing local wound care, and providing organization support. In the overview of debridement methods considerations and contraindications, mechanical debridement (wet-to-dry dressings) considerations include: larger wounds, nonsurgical candidates, nonselective, painful, frequent costly dressing changes, bleeding, dispersal of bacteria when removed, and traditional rather than modern accepted practice (Kirshen et al., 2006).

Beitz (2012) examined the methods of debridement in both acute and chronic wounds, healing barriers, and healing facilitators for wounds. The author cites the necessity for practices by both the National Guideline Clearing House and the Cochrane review due to the lack of evidence-based guidelines for debridement. Beitz discusses a current national project being developed by wound care experts to develop an algorithm to assist healthcare providers with clinical wound decisions on what type of debridement should be used for primary or secondary wounds. The uses for different techniques of debridement are available providing advantages, disadvantages, and contraindications for each method (Beitz, 2012).

Schultz et al. (2003) compares the different modalities for debridement of acute to chronic wound healing stating that different modalities are needed to treat each. The role of debridement in acute wounds is analyzed at a biochemical process that occurs automatically through the use of enzymes secreted by neutrophils including elastase, and collagenase. Debridement initiates the healing process via the release enzymes; the role of occlusive and semiocclusive dressings are discussed in the use of debridement. Schultz et al, cited a study conducted by Hutchinson and Lawrence (1991) that proved “moisture retentive” or occlusive dressings had lower infection rates (2.6%) compared to gauze dressings (7.6%) (Hutchinson, & Lawrence, 1991). Another study by Geronemus and Robins (1982) was cited as it found moist wound environments accelerate wound healing by 50% (Schultz et al., 2003).

The Wound Healing and Management Node Group (2011) determine best practices for the use of wet-to-dry dressings through a literature review that included; Armstrong and Price (2004), Cowan and Stechmiller (2009), Ovington (2002), and Lawrence (1994) to base future recommendations. They found that wounds with moisture retentive dressings have better outcomes than those with gauze dressings. Recommendations for the use of wet-to-dry dressings are only indicated for debridement, but other modalities should be considered first as mechanical debridement is painful and damaging to granulating tissue (The Wound Healing and Management Node Group, 2011).

Discussion

Clinical management of complex surgical wounds is essential for the promotion and optimal wound healing environment. The Center for Disease Control and Prevention (2010) highlighted the risk of hospital associated infections and the subsequent financial burden related to improper wound closure and treatment. Debridement is a necessary process practiced in wound care to remove necrotic tissue from the wound bed in order to accelerate the healing process. Wet-to-dry dressings are one of the oldest and most common techniques for debridement in healthcare facilities (Spear, 2008). This review of literature revealed the scarcity of evidence based practice and guidelines for this technique.

Winter's (1962) study of scab formation in pigs, provided critical questioning of the wet-to-dry technique for wound management. The study indicates dried wound beds healed slower than those kept moist. Gauze soaked in sterile normal saline are isotonic and once evaporated, the dressing itself becomes hypertonic thus drawing fluid from the wound bed and drying it out (Winter, 1962; Spear, 2008; Kim, Saliba, Smith, McTavish, Raine, & Curtin, 2000; Ovington, 2002). According to Schultz et al (2003), moist wound beds heal 50% faster than dry wounds because it promotes autolytic debridement, migration of epithelial cells, matrix formation, and therefore accelerates tissue granulation.

Advantages of wet-to-dry dressing debridement

The wet-to-dry method is utilized for patients who have large wounds with heavy necrosis healing by secondary intention or for nonsurgical candidates (Beitz, 2012; Wound Healing Management Node Group, 2011). Many physicians choose wet-to-dry mechanical debridement over other choices due to preference, tradition, and simplicity (Armstrong, & Price, 2004; Cowan, & Stechmiller, 2009; Beitz, 2012; Spear, 2008). The procedure is convenient for healthcare professionals since materials are readily available, and it can be performed at the bedside by Registered Nurses. However, studies conducted by Armstrong and Price (2004), and Cowan and Stechmiller (2009) concluded that healthcare professionals are inappropriately selecting wet-to-dry dressings and sequential debridement placing the patient at risk for reinjury and unnecessary pain

Disadvantages of wet-to-dry dressing debridement

Wet-to-dry dressing debridement is nonselective; it removes both necrotic and newly formed granulation tissue placing the wound at risk for reinjury and causing unnecessary pain to the patient (Spear, 2008; Beitz, 2012; Ovington, 2002). This process may damage surrounding capillaries leading to bleeding and increased exposure to outside pathogens (Beitz, 2012). As previously discussed, wet-to-dry dressings draw moisture from the wound that can hinder the healing process; once the fluid evaporates, it will cool the tissue causing vasoconstriction leading to a decrease in blood flow, therefore depriving the tissue of blood products and proteins essential for healthy tissue growth. Decreased tissue perfusion also places a patient at higher risk for infection as the innate immune system is affected (Ovington, 2002). Research conducted by Lawrence (1994), demonstrated that 64 layers of gauze was not a sufficient barrier to prevent infection by exogenous bacteria. The author concluded that if a wound that is being debrided is not yet infected, the use of gauze in wet-to-dry dressings will increase the likeliness for infection (Lawrence, 1994; Ovington, 2002; Beitz, 2012). Wound dressing removal is painful for the patient and increases the risk for cross contamination. Hand-held air samplers were utilized to determine if bacteria were dispersed airborne during the removal of dry gauze; it was found that high levels of microbes were released into the air that could potentially lead to cross contamination if other wounds are present, reinfection of current wounds, or polymicrobial colonization increasing a person's risk for resistant bacterial infections (Lawrence, 1994; Ovington, 2002; Beitz, 2012).

Financial impact is a healthcare concern. Wet-to-dry dressings are considered a cost effective method for debridement based upon a low "unit cost" of less than 3 dollars for supplies where as other modern dressings may cost up to 17 dollars. However, research has proven this technique is actually more costly than other forms of debridement once all direct costs are taken into account. In order to estimate the real cost of debridement, dressings and supplies, labor costs, and services must be accounted for (Ovington, 2002). In a cost comparison study by Mosher et al (1999), 4 different debridement methods were evaluated (enzymatic, autolysis, fibrinolysin, and wet-to-dry) to see which was most cost efficient. It was found that wet-to-dry dressings were the most expensive (weighted average cost of treatment (WACT) $36.03 a day) due to frequent dressing changes (2 to 4 times a day), labor cost, and analgesics to decrease pain (Ovington, 2002; Beitz, 2012; Spear, 2008; Mosher et al, 1999). Collagenase (used for enzymatic debridement) was found to be the most cost efficient averaging $21.82 a day for treatment. Wet-to-dry dressings are approximately 65% more expensive when compared to modern debridement practices (Mosher et al, 1999).

Current debridement practices

With a multitude of different debridement practices available today, mechanical debridement via wet-to-dry dressings still is the most common method utilized in the United States healthcare industry regardless of the type of wound and the patient's healing profile. Current research has been unable to prove the efficiency of wet-to-dry dressings, but it is continually utilized in the United States even though there is little evidence to support its use. The United Kingdom and other industrialized nations rarely use this method as modern practices are more selective and less painful for patients (Gwynne, & Newton, 2006). Institutions are slowly gravitating towards newer methods for debridement as a new generation of physicians and nurses alike are being introduced into the healthcare field.

Alternative methods of debridement

Newer, more selective alternative methods of debridement are being explored, because they have proven to be more efficient both clinically and financially. Specifically, autolytic, enzymatic, and surgical debridement are at the forefront of technology as healthcare professionals are advancing in their education and strive to provide care that is evidence-based. It is important to note that each type of debridement is used in different scenarios, and not one method of debridement can be used in all cases.

Autolytic Debridement

Autolytic debridement is the safest method for wound debridement as it uses the body's own endogenous enzymes and phagocytic cells to break down, liquefy, and separate necrotic tissue from healthy tissue (Schultz et al, 2003; Gwynne, & Newton, 2006). This is accomplished utilizing modern occlusive dressings (such as hydrocolloid dressings) which maintains a moist environment for optimal wound healing (Spear, 2010; Gwynne, & Newton, 2006; Schultz et al, 2003 Hydrocolloid dressings contain polymers and adhesives that are activated in the presence of wound exudates; the fluid will seal the wound shut keeping the wound moist, therefore stimulating growth factors and proteases to degrade nonviable tissue and stimulate epithelial regeneration (Kirshen et al., 2006). Autolytic debridement is far less painful than wet-to-dry dressing changes because tissue is not ripped from the site of injury and the nerve ends are covered and kept hydrated in the wound bed (Beitz, 2012). A disadvantage for this method of debridement is that it is a slow process and should not be used in wounds that have a heavy necrotic burden with a high bacteria load (Spear, 2010; Schultz et al., 2003; Beitz, 2006). Autolytic debridement with the use of hydrocolloid dressings has been proven more cost and time effective leading to faster wound healing then wet-to-dry dressing debridement (Kirshen et al., 2006; Ovington 2002; Mosher et al., 1999).

Enzymatic debridement

Exogenous enzymes such as collagenase, papain, and fibrinolysin/DNase are placed in the wound and work with a person's endogenous enzymes to debride the necrotic tissue. Collagenase is commonly used as it is the most specific enzyme available and the only one that is approved by the Food and Drug Administration (Schulz et al., 2003; Kirshen et al., 2006; Spear, 2010). Collagenase works by cleaving the amino acid glycine from collagen leading to its degradation signaling the body's autolytic mechanism to take over. Collagenase enhances the body's ability to get rid of necrotic tissues selectively while increasing chemotaxis of keratinocytes leading to quicker granulation rates (Schultz et al., 2003; Spear, 2008; Kirshen et al., 2006). Enzymatic debridement is relatively painless and is quicker than using wet-to-dry dressings and more cost efficient since dressings need changing once every 1 to 3 days (Schultz et al., 2003; Mosher et al., 1999). This method can be used in conjunction with antibiotics for wounds that are infected and are a good alternative to wet-to-dry dressings as it is more selective and less traumatic to the wound. Enzymatic debridement is indicated for patients on anticoagulants, or those who are not good candidates for surgery (Beitz, 2012).

Surgical debridement

This technique is best utilized for wounds that need aggressive treatments such as those with a heavy necrotic burden, sepsis, and deep or advanced infection such as necrotizing fasciitis (Beitz, 2012). Surgical and sharp debridement is clinically more efficient than wet-to-dry dressings; however, it is very painful, expensive and specially trained healthcare providers need to perform the procedure. Surgical debridement patients usually have better outcomes compared to those who undergo mechanical debridement (Beitz, 2012; Kirshen et al., 2006).

Implications

Research

Wet-to-dry dressings are continually being used with little evidence to support the practice; more research is needed to compare wet-to-dry dressings with other types of debridement. The review of literature provided little to no set guidelines for best debridement techniques and practices with generalized, broad terms; more specific definitions of methods and materials should be reported. Evidence based research is needed to establish guidelines and protocols for wet-to-dry dressings, and to compare this technique with other types of debridement. Research studies should include evidence based interventions, patient efficacy, approximate time for wound healings, and indications for each technique. The lack of research on acute wound care and best debridement practices highlights the need to conduct more pilot and randomized control trials with large sample sizes.

Practice

Healthcare providers need to be able to properly assess an individual's wound healing profile; identifying comorbidities, vascularization, and nutrition, along with the type, size, and colonization of the wound. A patient's healing profile is unique and the best debridement method will vary for each person. Prescribers need to be well versed in all types of debridement, know their proper uses, benefits, and risks of each. Properly educated healthcare professionals will be able to make their decisions based upon evidence and not tradition providing the best patient outcomes both clinically and financially. Nurses are important in the arena of wound care; they act as advocates for the patient. In one recent study, a private home health care agency implemented a ban on wet-to-dry dressings after performing a root-cause analysis that implicated their use as a contributor to increased infection rates. By taking a stand and implementing a program banning wet-to-dry dressings, the organization and nurses advocated for their patients based on evidence and as a result 2 other agencies followed suit.

(Dale, 2011). It may be drastic to ban wet-to-dry dressings as they are a viable option in some cases, however, it is within a healthcare professionals scope to question debridement orders if a better option is available for the patient. By not advocating for best practices, nurses, and facilities alike are becoming complacent to tradition and encouraging the use of outdated methods.

Education

Education of different types of debridement should begin in the classroom; curricula need to include all types of debridement and practical uses for them all. This may pose a challenge as many educators are tied to tradition. Educating future healthcare professionals on assessing the patient as a whole in order to make the decisions of wound care practices is essential in obtaining the best patient outcomes possible. As an industrialized country, the United States needs to be more progressive in the area of wound care and base clinical decisions on evidence rather than tradition.

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