Wound Dressing Techniques and Costs at a County Hospital

Pamela Amatta Odhiambo, Kennedy Omondi, Ng'wena Magak

School of Medicine, Maseno University

Correspondence to: Pamela Amatta Odhiambo, P. O Box 3838–40100 Kisumu, Kenya.
Email: amatta19@gmail.com

Abstract

Background: Wound management is one of the commonest procedures conducted in surgical departments across health facilities in Kenya. **Objective:** This study aimed at exploring wound dressing techniques used at Migori County Referral Hospital (MCRH) and the cost of treatment to patients. **Methods:** Convenience sampling was used to select inpatients presenting with wounds undergoing treatment at the time of recruitment. Five patients (2 male and 3 female) were enrolled after obtaining informed consents. Wounds were examined during cleaning and dressing and healing process follow-ups made. Selection of wound dressing technique was done by the primary clinicians with no bias from the research team. **Results:** One patient's wound was an open fracture resulting from a road traffic accident; three patients had pyomyositis following thorn pricks; and the last patient's was sustained following a blast injury. Wound management methods employed at MCRH included cleaning with vinegar, irrigation with normal saline, dressing with honey, and improvised negative pressure wound therapy. Total cost incurred was affordable to patients, and ranged between Kenya shillings 100–360 (US$1.00–3.60) weekly. **Conclusion:** Wound management techniques at MCRH were effective and affordable. Additional studies with a larger sample size are recommended.

Key words: Wound dressing, costs, NPWT, vinegar cleaning, honey dressing
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Introduction

Wound care is one of the most common procedures conducted in surgical departments across health facilities in Kenya. Migori County Referral Hospital (MCRH) is a level four facility serving a population of 917,190 residents (1). With advances in healthcare delivery coupled with rapidly evolving antibiotic resistance by most microorganisms, wound care is rapidly developing (2). Different methods are used in wound care in different areas of the world, depending on wound type and expertise availability (3). Negative pressure wound therapy (NPWT) has been successfully used in several parts of the world since its invention (4). However, resource-limited facilities cannot implement the exact technique of NPWT and thus have had to improvise, without compromising the outcome (5). The aim of the study was to describe the types of wound dressing techniques used at MCRH. The cost associated with dressing was also determined for each technique.

Methods

This is a case series of consenting patients treated for acute wounds in the surgical wards of MRCH for 6 weeks. Patients with pre-existing diabetes mellitus or peripheral vascular disease were excluded. History, biodata and examination findings were documented. The techniques applied for wound dressing were observed and documented progressively until the patients were discharged from hospital. Estimates of daily and cumulative cost of the dressing materials were generated. Quantitative data are presented as tables while the techniques are described qualitatively. Ethical clearance and permission to conduct the study was obtained from the medical superintendent's office.

Results

Nine patients were admitted to MCRH with various wounds; of these four were excluded, leaving two males and three females. Table 1 shows the demographic and clinical profiles of the patients studied.

and three females. Table 1 shows the demographic and clinical profiles of the patients studied.

Table 1: Patient demographics and wound care methods

Study code	Age (yrs)	Gender	Days to presentation	Other risk factors	Wound dressing method used	Presence of complications
MGR001	14	F	6	Presented a week later	NPWT and honey dressing	None
MGR002	75	F	2	Elderly; Initially had pyomyositis which then developed into an open wound	Vinegar an honey dressing	None
MGR003	45	F	0	Obesity	Irrigation with norma saline and honey dressing	Yes (open fracture)
MGR004	39	M	2	Initially had pyomyositis which then developed into an open wound	Iodine	None
MGR005	28	M	0	None	Irrigation with norma saline	None

Wound Dressing Techniques Used

Improvised Negative Pressure Wound Therapy

Negative pressure wound therapy (NPWT) was applied after initial surgical debridement on a patient with a degloving wound on the palmar aspect of the right hand following explosion of an unknown device. Materials used included sterile gauze pad, normal saline (250 mL), natural honey (8 mL) and one tubal end of a urine bag.

Three layers of gauze were created. A piece of sterile gauze soaked in normal saline was applied on the wound bed. This was followed by a layer of a piece of dry gauze to cover all parts of the first layer while ensuring there was no contact with intact skin. The third layer consisted of gauze with a thin layer of honey. This was covered with a piece of dry gauze. The end-tube of a sterile urine bag was then placed on the top layer of gauze and covered with dry gauze. The entire dressing was sealed with cling film and secured using zinc oxide strapping. Next, the other end of the tube was connected to the suction machine set at –95 mmHg.

The dressing was changed at 24, 48 and 96 hours post application. A second debridement was performed on day 4, followed by subsequent dressings every third day.

Use of Vinegar and Honey

One patient with a wound on the dorsum of the foot following debridement for pyomyositis underwent this procedure. Materials required were one part vinegar (15 mL) mixed with two parts normal saline (30 mL). This mixture was then used to clean the wound, followed by dressing with a thin layer of gauze secured in place by zinc oxide strapping. This was repeated every day for six consecutive days. Prior to each dressing, the wound was soaked in warm water for about 30 minutes.

Irrigation with Normal Saline and Honey

This technique was applied to a patient with an open fracture of the distal third of the tibia. The wound was soaked in warm normal saline for approximately 30 minutes. The wound was irrigated with normal saline to wash off any loose debris and dead tissue until spontaneous bleeding was noted from the wound surface. Bleeding was controlled by applying pressure and a dressing soaked in honey. The dressing was covered with dry gauze and secured along the edges.

Use of Iodine

Iodine was used on a patient with pyomyositis secondary to a thorn prick, resulting in an open wound following debridement. The wound was cleaned with normal saline, as described above. Iodine solution (10 mL) was placed on gauze, applied on the wound surface and left to dry.

Irrigation with Normal Saline

The wound was cleaned as described above and then covered with a thin sheet of moist gauze. The gauze was strapped at the edges to keep it in place.

Cost Incurred by Patients for Various Wound Dressing Techniques

Table 2 shows the cost of the various dressing techniques which range from USD 1.00 to 3.60.

Assessment of the cost of purchasing various materials used for wound care techniques at MCRH

Individual and total item costs are given in Kenya Shillings (KES) and United States dollars (US$). The approximated currency exchange rate is KES 100.00 to US$1.00.

Discussion

Several techniques were used at the MCRH to dress wounds. Wet to dry dressing is not encouraged since it causes wounds to dry out, leading to bleeding and destruction of the layer of tissue as the dressings are changed, which eventually

Table 2: Costs incurred by the patients

Wound dressing technique	Material used	Individual material cost		Total material cost	
		KES	US$	KES	US$
Negative pressure wound therapy	Normal saline (500 mL)	50.0	0.50	360.0	3.60
	Gauze (8 small packs): dressing pack with gauze, strapping	50.0	0.50		
	cling film (lasts for 2 weeks)	135.0	1.35		
	Honey	125.0	1.25		
Honey dressing	Normal saline (500 mL)	50.0	0.50	225.0	2.25
	Gauze (8 small packs): dressing pack with gauze, strapping	50.0	0.50		
	Honey	125.0	1.25		
Irrigation with normal saline	Normal saline (500 mL)	50.0	0.50	100.0	1.00
	Gauze (8 small packs): dressing pack with gauze, strapping	50.0	0.50		
Iodine application	Normal saline (500 mL)	50.0	0.50	100.0	1.00
	Gauze (8 small packs): Dressing pack with gauze, strapping, Iodine	50.0	0.50		
Vinegar sressing	Normal saline (500 mL)	50.0	0.50	190.0	1.90
	Gauze (8 small packs): sressing pack with gauze, strapping	50.0	0.50		
	Vinegar	90.0	0.90		

slows the healing process (6). NPWT uses continuous or intermittent sub-atmospheric pressure applied directly to a wound bed to assist healing (7). The optimal pressure to be used is approximately –125 mmHg, using an alternating pressure cycle of 5 minutes of suction followed by 2 minutes off suction (8). It works by optimizing blood supply to the wound are and decreasing local and peripheral tissue edema; the reduced edema then leads to rapid cell regeneration and proliferation in the wound (9). It also reduces bacterial biofilm at the wound bed. In addition, the intermittent low pressure alters the structure of the cells in the wound area, which then triggers an inflammatory and proliferative cascade that increases the rate of formation of granulation tissue (6). The technique has been in use for about 30 years (10). In MCRH, the improvised NPWT worked effectively in aiding wound healing despite the limitations surrounding the technique.

In the ideal set up, a fitting foam dressing is first cut and placed gently over the wound and a draining tube is the placed above the dressing. The dressing is finally covered with adhesive transparent tape (11). In the present study, the foam was substituted with the layers of gauze (12). Most foam dressings are laced with antibiotics, but a modification in the results technique presented here used honey dressing. In addition, the cling film and urine bag tubing substituted transparent adhesive tape and the drain system, respectively. Fluid in the wound was suctioned by the modified foam to a disposable canister in the negative pressure unit, a suction machine canister in the present study. The dressings were changed every 48 hours and in the presence of an existing wound infection or electric power fluctuations, every 24 hours. Results presented here showed no infection or accumulation of pus after 24 or 48 hours. These results were consistent with previous observations that showed the dressing may be required for 2–6 weeks, depending on the wound type and the rate of wound healing (13).

The disadvantages of this technique include the need to be connected to a machine for at least 22 hours in a day and initial pain from applying pressure. Potential complications that may arise that warrant discontinuation of the therapy include tubing pressure necrosis, injury to the adjoining skin, growth of granulation tissue within the strands of the foam dressing, contact dermatitis due to the adhesive tape, formation of fistulas and, in rare cases, skin cancer due to increased blood flow in the wound bed (14).

A previous analysis of treatment showed an approximate cost for a fully functional NPWT to the patient is approximately €140 (USD 180) weekly excluding the re-usable NPWT system. Another study places the cost at US$119,224 per 1,000 days (14). On the contrary, the cost incurred by the patients on improvised NPWT in MCRH was KES 360.00 (US$3.60) per week (Table 2). This is comparatively more cost effective and can be achieved especially in resource-limited settings.

Honey has been used in wound therapy for several decades. Recent studies have shown that honey has an inhibitory effect on approximately 60 bacteria species and acts against both aerobes and anaerobes (15). In addition, it has antifungal action against *Aspergillus* species, yeast and dermatophytes (16). Manuka honey, produced in New Zealand, has been shown to contain rich chemical ingredients that have, among others, antioxidant effects that aid in rapid wound healing and faster tissue regeneration (15).

The advantages of honey include a high osmotic effect on wounds, which inhibits microbial growth, allowing creation of a perfect osmotic gradient that would mop up exudate from the wound, enabling faster healing. In addition, the sugar content including fructose (40%), glucose (30%) and 5% sucrose provides sufficient substrate for microorganisms and therefore prevents them from obtaining substrates directly from the wound site, effectively decreasing formation of bacterial biofilms (17). Honey contains an enzyme, Inhibin that yields small

quantities of hydrogen peroxide. The hydrogen peroxide concentration in honey is 1000 times less than in the 3% solution commonly used as an antiseptic (20). Its low pH inhibits the growth of bacteria and its components provide an antioxidant effect (18, 19). Previous studies have associated honey with increased phagocytic and lymphocytic activity on a wound (17).

In the current study, pure natural honey was used. Although no comparative studies on the cost of using honey in wound care were obtained, total cost incurred by the patient was determined to be KES 225.00 (US$2.25) per week.

Wound debridement and irrigation with normal saline form a critical step in wound healing. This is because normal saline? enables rapid progression from the inflammatory to proliferative phase of wound healing by removing debris that can negatively affect the entire healing process. Irrigation, especially with higher pressures, helps prevent premature surface healing above an infected tract or an abscess pocket (20).

Other solutions used as irrigants include topical cleansers, antibiotics, antifungals, antiseptics and anesthetics. However, antiseptic solutions such as povidone-iodine, chlorhexidine, and hydrogen peroxide have been shown to be toxic to tissues and may negatively affect acute wound healing (19).

We estimated the cost incurred by patients who required irrigation with normal saline and dressing with sterile gauze to be approximately KES 100.00 (US$1.00) per week. No comparative studies on the cost were obtained.

Iodine has been used for wound cleaning for a very long time. However, it is currently being phased out globally because studies have associated it with tissue necrosis (20). In spite of its this? effects, iodine is used for wound debridement, prevention of infection on new wound surfaces, and promotion of wound healing via activation of monocytes and macrophages. Of the two types commercially available, povidone-iodine is frequently used due to its positive influence effect? on growth of fibroblasts, which boosts regeneration of the wound (9).

The cost incurred by this procedure was approximately KES100 (US$1.00) per week at MCRH. This cost was similar to the cost of irrigating with normal saline since the dressing pack comes with iodine and the clinician decides whether to use it.

Recent studies on vinegar use on wounds have demonstrated presence of several antimicrobial properties that include inhibiting growth of group D *Enterococcus, Staphylococcus aureus, Escherichia coli* and *Pseudomonas aeruginosa,* thereby reducing the amount of bacterial biofilm present on the surface of the wound. The bactericidal acetic acid present in vinegar helps minimize chances of infection and accelerates the rate of wound healing (7).

However, vinegar must be diluted first to prevent toxicity to the tissues. Thus, the procedure requires initial wound debridement, diluting the vinegar with normal saline at a ratio of 1:2, and then applying it to the wound surface. Vinegar has been shown to slow wound healing but that was not possible to evaluate in this series. In addition, applying honey and vinegar concurrently was not practiced in MCRH, although previous studies have shown effectiveness in alleviating pain and increased antimicrobial activity (7). The total cost per week of using normal saline irrigation and vinegar application on a wound was KES 190 (US$1.90).

We recommend larger follow-up studies, incorporating chronic wounds, to quantify the wound healing rates as well as wound care costs using the techniques we have observed. Such local wound care products should be availed to healthcare providers to expand the choices in wound management.

Conclusion

The different wound dressing techniques used in MCRH were shown to be effective, efficient and cost effective. They are easy to perform (including modified NPWT) and can easily be incorporated into resource-constrained health settings with good outcomes.

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