

Research Article

Best and Effective Practices of Wound Care and Healing Among Patients with Diabetes Mellitus

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Abstract

Aim: With the continuing trend in the incidence of diabetic ulcer, current researches from evidence-based practice augment best and effective practices on wound care and healing among patients suffering from diabetes mellitus.

Methods: This study utilized a systematic review of literatures in light of wound care through Pub Med database with the key words "Diabetes Mellitus," "wound practices," "wound healing," and "systematic review." The searched literatures were of case reports, interventional studies, and review papers whose main texts were in English.

Results: There were 7,988 published articles yielded from the keywords used and 16 were included in this study. The practiced management and techniques in these literatures focused on comfortable and cost efficient means of wound care and healing with the involvement of group participation than individual plan of care.

Conclusions: There are meager evidences for vigorous wound and healing options that needs further studies in resolving wound issues among patients with Diabetes Mellitus. This systematic review establishes the insufficiency of high level of evidence based studies on wound healing in DM patients and brings a track for continuity of rigid studies concerning this topic.

Implications for Nursing Practice and/or Health Policy: Understanding innovative wound care is the chance for nursing professionals to associate evidence, expert opinion and patients' preference for a best and effective practices of wound care and healing and thus eventually make them a step above their skills. The evolution of different treatment regimens like hyperbaric O₂ therapy, TCOT device, natural latex associated with the LED circuit, low-level laser therapy, PRP treatment, salt-based spray, Telemedicine follow up, cord platelet gel application, Human Reticular Acellular Dermal Matrix, and acellular reticular allogenic human dermis will not only aid in the management of wound care and healing but also in strengthening the comprehensive and practical skills among nurses.

Keywords: Diabetes Mellitus, Systematic Review, Wound Care and Practices, Wound Healing

Introduction

Wounds are commonly categorized as chronic or acute and could rise from any traumatic damage or through a collapse of an unharmed skin [1]. Healthy people have strong skin integrity with a significant ability for healing but can be exposed to outer and inner harm brought about by older age and changed in physiology [2]. This can be intrinsic or extrinsic in nature. In people suffering from diabetes, healing of lesions is slow but progresses faster. It is therefore essential to understand diabetes and appropriate wound care along with the complexities of wound management and understanding for a better life and longevity. The incidence of diabetes is escalating faster in the countries of middle and low revenues and in 2014; a global data of 8.5% came from people aging 18 years old and above [3]. But the occurrence of diabetic foot ulcers is within 4% and 10% with 1:4 threat of having diabetic foot ulcer in their life [4].

Although minor injuries like burns, abrasions and lesions are normal accidents; these can bring severe medical concerns to people with diabetes [5]. Local infection can extend fast to the internal parts of the body and can be fatal. Studies suggests that curing of wounds is affected by: weakening in producing hormones related with development and therapy, decreasing in producing and repairing of new blood vessels, weakening of skin protection, and decreasing in the production of collagen [5]. There are recent studies that can help in bringing effective management of wound care among patients with diabetes. These are helpful practices that can save limbs for amputation.

This review is an investigation on the efficacy of different practices of healthcare professionals in the conduct of wound care and healing among patients suffering from diabetes. It has unveiled comfortable management of diabetic wounds as well as hopes to patients with DM to salvage their limbs. It is with the same reason why the author

conducted this review. Results stated different practices and effects and there is a solid reason for more evidence-based studies that will heighten the rate of wound healing and introduce patients with DM easy to carry out wound care and practices. This study commenced to explore the different practices in wound care for patients with diabetes using systematic review of published evidence-based studies on wound management in diabetes.

Methods

The research composition of this systematic review to unveil different practices on wound care and healing among patients with diabetes mellitus. Pub Med database was searched for relevant literatures through keywords “Diabetes Mellitus,” “wound practices,” “wound healing,” and “systematic review.” It was piloted on November 1, 2018 and focused the search on case reports, interventional studies,

and review papers written in English language. The focus of the search is practices and wound care that would lead to wound healing. Yielded published articles were systematically evaluated based on the country of the author, year the article is published, site of the study, method and design of the study, management team, and the results. Prior synthesis, data is extracted via two reviewers and reviewed for accuracy by another reviewer. Inconsistencies are being identified for illegibility and consensus while recognizing ineligible based on the criteria.

Results

With the use of keywords yielded 7,988 published articles on wound management among patients with DM but only 16 fulfilled the criteria set in this study for review. Relevant data is summarized in (Table 1).

Table 1. Physiognomies of Selected Studies: Best and Effective Practices of Wound Care and Healing Among Diabetic Patients.

Author; year published; title of the study	Sample; wound type	Study design	Team composition	Intervention and period of coverage	Primary Outcome	Major results
Chang (2018)	274, Diabetic foot	Single-center retrospective study	Surgeon	Patient evaluation, wound preparation, improving vascularity, surgery and dressing, and rehabilitation 2005–20017	Infection and arterial occlusion	Improved vascularity
Chen et al. (2017)	38, Chronic diabetic foot ulcer	Randomized controlled trial	Doctor, nurse	Intervention group receives standard care and HBOT while control group receives standard care only. 20 days	Wound closure	Improved wound healing
Crews & Candela (2018)	25, Diabetic foot ulcer	Randomized controlled trial	Doctor, PT	Patients at risk for DFU’s with removable cast walkers in 20 mins walking trials using 5 footwear conditions	Bilateral shoes brought better comfort	Ankle-high removable cast walker combined with contralateral limb lift increases offloading and improve healing
Driver (2017)	130, Foot ulcer	A prospective, randomized, blinded, multicenter, parallel study	Not mentioned	TCOT device given to intervention groups following assessment and standard care while the control group received the sham device following standard care. 12 weeks treatment	Good wound results in both groups	Beneficial to older population
Eraydin & Avsar (2018)	65, Diabetic foot ulcer	Randomized control trial	Nurses	Intervention group given standard wound care and foot exercises for 12 weeks while the control group had standard wound care with no exercise 12 weeks	Difference in the ulcer areas in the two groups	Significant decrease of ulcer area in the intervention group.
Health Quality Ontario (2017)	8; Ulcer	7 randomized controlled trials, 1 nonrandomized controlled trial	Experts, end users, and applicants	Review and assessment of studies concerning efficacy and cost effectiveness of HBOT utilizing the standpoint of the Ministry of Health and Long-Term Care and assessed the clinical evidence with the use of GRADE.	Mixed results on standard of care in rates of amputation while there is impact on standard care and HBOT and no difference on the adverse events on both.	Satisfaction on patients using HBOT and positive perceptions on healing

Author; year published; title of the study	Sample; wound type	Study design	Team composition	Intervention and period of coverage	Primary Outcome	Major results
Lopez-Delis (2018)	15, Lower limb ulcer	Randomized controlled trial	Nurses, patients	Group 1: recipients of dressing system adhesive of the natural latex associated with the LED circuit. Group 2: recipients of dressing at home with calcium alginate or silver foam Group 3: recipients of dressing at home with adhesive derived from the natural latex associated with the LED circuit. 1 month	Significant decrease in ROS formation	Latex and phototherapy brought better debridement and healing process
Mathur et al. (2017)	30, Grade 1 foot ulcer	Randomized clinical trial	Doctors, Nurses	Intervention group received low-level laser therapy with conventional therapy while control group only received conventional therapy 6 weeks	absolute and relative wound size reduction at 2 weeks compared to the baseline parameter.	results suggest that LLLT is beneficial as an adjunct to conventional therapy in the treatment of diabetic foot ulcers.
Mohammadi,et al. (2017)	100 Diabetic foot ulcer	A single-arm clinical trial	Doctor, nurses	Weekly PRP treatment following primary wound care	Significant decrease of the area of wound	Platelet-rich plasma gel as treatment for non-healing DFU
Park et al. (2018)	167 Diabetic foot ulcer	A phase III multicenter, double-blind, randomized, placebo-controlled trial	nurses	Routine wound care and topical or spray of saline with 0.005% rhEGF (n=82) or (n=85) twice a day 12 weeks	Comparable results between placebo groups and the rhGF groups	Faster healing velocity and higher complete healing rate regardless of HbA1c levels.
Pougatsch (2017)	10, Diabetic foot ulcer	Prospective, case-cohort study, Pilot study	Not mentioned	Used acceptable methods of cleansing and the use of salt-based spray then gauze sponges soaked with the spray is used to dress the ulcer and then covered with dry foam or gauze and wrap with ACE. 12 weeks	Wound closure	Viable natural wound care therapy
Santema et al. (2018)	120 Ischemic wound	DAMO_CLES multicenter randomized clinical trial	Not specified	40 sessions of HBOT was used for five days weekly or till complete wound healing was reached One month	Limb salvage and wound healing	Freedom from any amputation
Smith-Strøm et al. (2018)	165, Diabetic foot ulcer	cluster-randomized controlled non-inferiority trial	Doctors, Healthcare personnel, Community nurses	Intervention group utilized TM follow-up care in the community while the control group received SOC. 2012–2016	Faster Healing time	Technology as relevant alternative to wound care
Volpe et al. (2017)	20 Diabetic wound	Non-blinded, consecutive series, randomized clinical trial	Nurses Surgeons	Group A is managed with standard wound care while Group B is managed with topical application of CBPG consisted of platelet gel application 2 times a week in 4 weeks and then once a week for an additional 4 weeks. 2 months	Ulcer reduction	Rapid healing than standard technique
Zelen et al. (2017)	20, Diabetic foot	A retrospective crossover study	Not mentioned	Indolent DFUs are given acellular matrices 12 weeks	12 out of 20 were eligible for crossover treatment	Complete healing achieved

Author; year published; title of the study	Sample; wound type	Study design	Team composition	Intervention and period of coverage	Primary Outcome	Major results
Zelen et al. (2017)	40, Chronic diabetic ulcer	A prospective, randomized, controlled, multi-centre clinical study	Doctor Nurse	SOC group receives dressing change daily combined with collagen alginate while HR-ADM group received grafts. 12 weeks	Healing proportion of wounds in 6 weeks.	Clinical superiority of HR-ADM and considered cost effective

Country and Year of Publication

The selected studies were authored by researchers from Finland (2), Netherlands (2), Korea (2), USA (2), Italy (1), Norway (1), Iran (1), India (1), Brazil (1), Canada (1), Turkey (1), and Taiwan (1). These are written in English and were published from 2017–2018. Therefore, the papers used for review were recent and current as these are being published in a year time.

Sample

Only four of the 16 studies are of small sample (8, 10, 15, 20, and 20 cases). Most of the selected studies were of large sample (25, 30, 38, 40, 65, 100, 120, 130, 165, 167, and 274 cases correspondingly) resulting to a mean of 105 cases (SD: 77 cases). The kinds of wounds were specified in all cases and the leading type was diabetic foot ulcer.

Study Design

Five (5) studies used randomized control trials (RCTs). Others were combination of designs like: two (2) utilized retrospective study where one is a single centered while the other one is a cross-over; three (3) are prospective studies where one is randomized, blinded, multicenter, and parallel study, the second is prospective, case-cohort study, and a Pilot study, and the third is prospective, randomized, controlled, multi-center clinical study. One (1) study used 7 randomized controlled trials and 1 nonrandomized controlled trial. Others studies are: one (1) single-arm clinical trial; one (1) phase III multicenter, double-blind, randomized, placebo-controlled trial; one (1) DAMO₂CLES multicenter randomized clinical trial; one (1) cluster-randomized controlled non-inferiority trial; and one (1) Non-blinded, consecutive series, randomized clinical trial.

Management Team

Included studies were mostly composed of nurses and doctors. One had collaboration with experts, end users, and applicants. Two of the studies did not identify the composition of the healthcare team while another two studies included surgeons. There is no mention of inclusion of podiatry and orthotic studies

Intervention

Selected studies utilized both intervention and control groups where the control groups are given standard wound care following evaluation and rigid assessment. Some studies incorporate exercises while other studies add follow up care. The intervention groups are also given standard wound care and additional management that includes like hyperbaric O₂ therapy (HBOT), transdermal continuous oxygen therapy (TCOT) device, natural latex associated with the LED circuit,

low-level laser therapy, PRP treatment, salt-based spray, Telemedicine follow up, cord platelet gel application, Human Reticular Acellular Dermal Matrix, and acellular reticular allogenic human dermis. The identified interventions are of usual units of weeks.

Primary Outcome

Primary outcomes are of diverse occurrence. There is infection and arterial occlusion in improving vascularity, surgery, and rehabilitation as resulted in the single-center retrospective study of Chang [6]. In the use of HBOT, there is wound closure in the RCT of Chen et al., [7] utilizing HBOT while satisfaction and positive insights on healing is the result of 7 randomized controlled trials, 1 nonrandomized controlled trial by Health Quality Ontario [8] with primary outcomes of mixed results on standard of care in rates of amputation whereas there is impact on standard care and HBOT and no difference on the adverse events on both. The use of 5 footwear conditions as brought about by RCT of Crews and Candela [9] resulted to comfort from bilateral shoes. Santema et al. [10] used 40 sessions of HBOT five days a week or until complete wound healing was reached for limb salvage and wound healing.

TCOT on the other hand is used in intervention group in the prospective, randomized, blinded, multicenter, parallel study of Driver [11] brought no difference with the controlled group utilizing standard care. But in the RCT of Eraydin & Avsar [12] in the RCT, there is difference in the ulcer areas in the two groups where the intervention group is given standard wound care and foot exercises for 12 weeks while the control group had standard wound care with no exercise. The first elicited better wound area. The RTC of Lopez-Delis [13] used three groups for dressing. Group 1 is with natural latex related with LED circuit, group 2 is with calcium alginate or silver foam, and group 3 is with adhesive derived from the natural latex associated with the LED circuit. The primary outcome is significant decrease in reactive oxygen species (ROS) formation. Regarding laser therapy, RTC of Mathur et al. [14] brought out absolute and relative wound size reduction at 2 weeks compared to the baseline parameter where the intervention group had low-level laser therapy along with conventional therapy while control group only had conventional therapy. Another literature used Platelet-rich plasma (PRP) gel in the management of diabetic foot ulcer and Mohammadi, et al. [15] used a single-arm trial through weekly treatment after primary wound care and resulted primarily with significant decrease of the area of wound.

Comparable results between placebo groups and the recombinant human epidermal growth factor (rhGF) groups in the phase III multicenter, double-blind, randomized, placebo-controlled trial of Park et al [16] where routine wound care and topical or spray of

saline with 0.005% rhEGF is used two times a day. This means a faster healing velocity. Pougatsch [17] made a pilot study using acceptable methods of cleansing combined with salt-based spray then gauze sponges soaked with the spray to dress the ulcer and then covered with dry foam or gauze and wrap with ACE to bring a wound closure. Volpe et al. [18] used three groups for a non-blinded, consecutive series, randomized clinical trial where Group A is managed with standard wound care while Group B is managed with topical application of CBPG consisted of platelet gel application 2 times a week in 4 weeks and then once a week for an additional 4 weeks. The primary outcome resulted to ulcer area reduction. There is a faster healing time in the cluster-randomized controlled non-inferiority trial of Smith-Strøm et al. [19] using TM follow-up care in the community while control group received SOC. Zelen et al. [20, 21] made 2 studies. First is a retrospective crossover study where Indolent DFUs are given acellular matrices and 12 out of 20 were eligible for crossover treatment and a prospective, randomized, controlled, multi-centre clinical study using daily dressing change that is combined with collagen alginate while HR-ADM group received grafts for healing proportion of wounds. All these are suggestive of wound healing and limb improvement with regards to appearance and function.

Discussion

With the aim of the study to bring out evidence based practice on wound care and healing, systematic review was undertaken. The key words “Diabetes Mellitus,” “wound practices,” “wound healing,” and “systematic review” yielded articles focused on the comfort and efficiency of patients with the identified and utilized practices on wound care and healing. The researchers explored case reports, interventional studies, and review papers written in the English language. Extracted data includes name and country of the author, year the article is published, site of the study, method and design of the study, management team, and the results. The studies were reviewed by two reviewers and the third reviewer checked and identified inconsistencies based on the set criteria. Therefore, the search was carried out systematically well.

The studies were reviewed by two reviewers and the third reviewer checked and identified inconsistencies based on the set criteria. Therefore, the search was carried out systematically well. The setting of the studies selected for review is of diverse origin. Two studies came from Finland, Netherlands, Korea, and USA respectively while one study came from the countries; Italy, Norway, Iran, India, Brazil, Canada, Turkey, and Taiwan. These are published from 2017–2018. With the evolution of research in the medical arena today, evolution of treatment will come next. As diabetes is the medical condition, wound healing becomes a problem. Wound types among the selected literatures are of diabetic ulcer. The study consists of large sample with a mean of 105 cases (SD: 77). This suggests validity and reliability. There are 5 studies of randomized control trials while other studies mixed their designs.

There are 3 prospective studies; first, a randomized, blinded, multicenter, and parallel study, the second is prospective, case-cohort study, and a Pilot study, and the third is prospective, randomized, controlled, multi-center clinical study. One of the selected study

utilized 7 randomized controlled trials and 1 nonrandomized controlled trial. Other methods and designs used: single-arm clinical trial; phase III multicenter, double-blind, randomized, placebo-controlled trial; DAMO₂CLES multicenter randomized clinical trial; cluster-randomized controlled non-inferiority trial; and non-blinded, consecutive series, randomized clinical trial. The dates of publication considered for inclusion are from studies published from 2017–2018. This means that the current and newest practices on wound care and healing are collated for review and these were based from the past practices that gained the reputation of healing and care. Most of the studies are published in journals.

In the study, the compositions of the teams who carried out the intervention are mostly doctors and nurses. One study collaborated with experts, end users, and applicants while two of the studies did not pinpoint the composition of the team while another two studies included surgeons. Regarding identified management, there is an intervention group and the control group where the former use additional treatment regime after the standard wound assessment and care while the later receives the conventional or traditional standard care and assessment alone.

In the study, the compositions of the teams who carried out the intervention are mostly doctors and nurses. One study collaborated with experts, end users, and applicants while two of the studies did not pinpoint the composition of the team while another two studies included surgeons. Regarding identified management, there is an intervention group and the control group where the former use additional treatment regime after the standard wound assessment and care while the later receives the conventional or traditional standard care and assessment alone.

The said intervention group received HBOT, TCOT device, natural latex associated with the LED circuit, low-level laser therapy, PRP treatment, salt-based spray, Telemedicine follow up, cord platelet gel application, Human Reticular Acellular Dermal Matrix, and acellular reticular allogenic human dermis simultaneously. This brought relative results to wound healing. It also heightened healthcare practice to a more evolved and acceptable treatment level of comfort and healing. Also, the identified regimen is of faster time treatment with the usual unit, weeks. Although the identified practices are of varieties, these are of the same results. It brought comfort and it brought healing faster than the traditional care and assessment alone. The data suggests the same dilemma of patients in different places with regards to wound/ulcer healing. One researcher is as engaged as the other to promote skin integrity and wound healing. And since the studies are of recent evidences and breakthroughs, wound healing is empowered to bring patients with diabetes better physicality and grip of hope against diabetic ulcer. Therefore, as per data suggests there is relative reduction of wound size.

Implications for Nursing and Health Policy

Understanding innovative wound care is the chance for nursing professionals to associate evidence, expert opinion and patients' preference for a best and effective practices of wound care and healing and thus eventually give them a step above their skills. The evolution of nurses' role in wound care contributed to bridge the need for

specialist wound care guidance and globally, this role evolved to bring varieties of labels [22]. With the continuum of evidence-based studies empowered with technologies and other breakthroughs, nurses can improve their skills and hasten their knowledge for effective diabetic wound care. The influence of evidence-based practice and technology resonated through nursing practice, learning, and teachings patients' self-care.

Duttob, Chiarella & Curtis [22] discussed that there are claims directing to nurses contributory services resulting to improvement of patient care although it was hard to produce data concerning their impact on wound care but some researches direct to that bearing. Being part of the multidisciplinary team, nurses gain better skills and efficacy. Wounds International [23] in the article entitled, "International Best Practice Guidelines: Wound Management in Diabetic Foot Ulcers appraised the recommendations of the International Diabetes Foundation concerning the expert foot care group in including physicians having distinct attention in diabetes, individuals with informative skills, and individuals having recognized preparation in foot care. Comprehensively, this will be augmented by other specialists in the medical arena and soon, there will be improvement in the nursing practice along with the policies that strengthen it.

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