

Wound Bed Preparation Using Unripe Pawpaw in a Resource-poor Environment: A Prospective Study

Charles Chidiebele Maduba^{1*}, Ugochukwu Uzodimma Nnadozie¹, Victor Ifeanyichukwu Modekwe², Victoria Maduba³, Gabriel Maduwike Okorie¹, Valentine Okechukwu Onyebum^{4*}

1. Division of Plastic Surgery, Department of Surgery, Alex Ekwueme University Teaching Hospital Abakaliki, Ebonyi State Nigeria
2. Department of Surgery, Nnamdi Azikiwe University Teaching Hospital Nnewi, Anambra State Nigeria
3. Nursing Service Delivery, Alex Ekwueme Federal University Teaching Hospital Abakaliki Ebonyi State, Nigeria
4. Division of Urology, Department of Surgery, Alex Ekwueme Federal University Teaching Hospital, Abakaliki, Ebonyi State, Nigeria

*Corresponding Author:

Charles Chidiebele Maduba
Division of Plastic surgery
Department of Surgery
Alex Ekwueme University Teaching
Hospital Abakaliki, P.M.B 102
Abakaliki, Ebonyi State, Nigeria.

Tel.: +2348036017909

Email: charlesmaduba@gmail.com

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ABSTRACT

BACKGROUND

Chronic wounds affect mainly the productive age group in developing countries and stretch the limited healthcare facility. We aimed to establish the efficacy or otherwise of pawpaw dressing in management of common forms of wounds in resource-poor settings using the Nigerian pawpaw in humans.

METHODS

This study was a prospective research carried out at Alex Ekwueme Federal University Teaching Hospital Abakaliki Nigeria between September 2019 and August 2020 using patients with lower extremity wounds. Thirty patients who had lower extremity wounds that required debridement were enrolled in the study after giving consent. They had wound dressing with unripe pawpaw as an enzymatic debriding agent to evaluate the rapidity of eschar separation and bacterial clearance. The data obtained with a proforma were analyzed using IBM SPSS.

RESULTS

There were 16 males and 14 females with an average wound size of 127.13+103cm². Eschar separation occurred earliest after 3 d of dressing and the latest after 14 d with a mean period of 5.5+ 2.255 days. A case had negative bacterial culture on the first test. Others had a variable period of clearance with a maximum of 18 d and a mean of 6.73+3.750 days. Both eschar separation and bacterial clearance correlated positively with the wound size.

CONCLUSION

Wound bed preparation with unripe pawpaw dressing showed promising outcomes with rapid eschar and slough separation, and bacterial clearance resulting in a faster wound healing. This is recommended for wounds needing debridement in which the patients are not fit for anesthesia or could not afford the cost of surgery.

KEYWORDS

Eschar separation; Pawpaw dressing; Prospective preliminary study; Wound bed preparation

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INTRODUCTION

Wounds are a major burden confronting individuals in developing countries. They have been described as neglected epidemics with severe attendant morbidity and mortality¹. The need to opt for the fastest and cheapest modalities of treatment is always embraced. This is because the impact on the individual is far-reaching affecting the physiologic, social and emotional well-being of the individual. It has been rightly described as the microcosm of the individual². At the national stage, wounds have adverse effects on the economy due to the cost of care and the impact on manpower. In the developing countries where there is a peak incidence at the productive age range the economic impact is even more³.

The quest for a cheaper wound dressing product with a clinically proven efficacy in an economically constrained environment drives the search for a readily available and easily affordable agent. The commonest non-surgical methods of wound debridement are mechanical, enzymatic, autolytic and biological⁴. Biological method of dressing which uses maggots only serves a historical purpose at present in our setting. The use of either normal saline or honey for autolytic debridement is the most common non-surgical form of debridement in our center. The use of honey however is preferred in our environment due to its antibacterial and other wound healing effects compared to normal saline. This has also led to an increase in the price of both wound-compatible honey and non-wound compatible types. Pawpaw (papaya) on the other hand is readily available in the tropics. It is very rich in collagenase among other enzymes and organic compounds that aid in wound healing. It is known to show antibacterial effect by destroying the biofilm under which the organisms protect themselves from both the host immunity and harsh environment. Pawpaw also has a high level of ascorbic acid which contributes to granulation tissue formation. The proteolytic enzymes, papain and chymopapain, aid in slough clearance. The antioxidant properties help shield the tissue from oxidative stress⁵.

Several causes of wounds are known such as trauma, malignance, diabetes mellitus, specific and non-specific infective agents, neuropathic conditions, hemoglobinopathies, vascular causes, and several other miscellaneous causes either in isolation or

in combination⁶. In developing countries, trauma is a leading cause while in developed countries, the leading cause is chronic venous insufficiency⁷. Diabetes mellitus is also a major cause of chronic wounds and the commonest cause of lower extremity amputation in developed countries⁸.

Wound care requires multiple theatre sessions for debridement preparatory for the ultimate operative wound cover. The financial burden is hardly affordable to such patients in developing countries. The wound care surgeons often resort to serial bedside debridement to ease the patients of financial burden. This is often frustrated by pains, bleeding, insufficient sloughectomy and poor patient compliance. The need for alternative method of wound desloughing strongly necessitates the use of Nigerian papaya in our environment in southeast Nigeria. Although Indian papaya has been used for a similar study in deep dermal burns wounds, we do not have any study using the Nigerian papaya for cleansing the very common forms of wound in the environment⁵.

The Nigerian pawpaw has been used for a study in animal models with a proven efficacy⁹. It may have a similar effect in humans especially because pawpaw in other climes have shown proven efficacy in wound management. It is readily available in Nigeria being the leading grower in Africa.[10] This study aimed to establish the efficacy or otherwise of pawpaw dressing in management of common forms of wounds in resource-poor settings using the Nigerian pawpaw in humans.

METHODS

This is a hospital based prospective study carried out at Alex Ekwueme Federal University Teaching Hospital Abakaliki Nigeria between September 2019 and August 2020 using involving inpatients with lower extremity wounds covered with slough and/or necrotic tissue. This study was carried out following ethical approval from the Alex Ekwueme Federal University Teaching Hospital Abakaliki.

All patients with diabetic foot ulcers of Wagner Grades 1-3 whose wounds needed debridement were enrolled into the study provided they gave consent. Diabetic wounds irrespective of their location in the lower limb were included in the study provided they needed debridement. All post-infective, sickle cell, venous and post-traumatic ulcers, and pressure

sores were included after giving their consent for the research. Malignant ulcers, arterial ulcers and ulcers in smokers, steroid abusers and Wagner 4 and 5 diabetic foot ulcers were excluded from the study. All patients who declined consent were excluded from the study.

In our environment surgical intervention is still dreaded especially when a patient discovers there would be multiple theatre sessions. Such patients readily opt for a non-surgical preliminary wound care options. They were recruited and wound evaluated to determine if they meet the criteria for the plan. All patients meeting the criteria for procedure were further counseled before commencement of the dressing protocol. Multiple sessions were required depending on the clinical response.

Unripe pawpaw was used since it has higher concentration of collagenase than the ripe ones. The selected pawpaw was washed with antiseptic lotions, chlorhexidine/cetrimide and methylated spirit. It was then peeled in sterile wound dressing trolley and sliced. The slices were then applied to the wound directly after wound toileting with normal saline and wound swab taken for microscopy, culture and sensitivity by Levine method. In this method, the wound swab was taken by pressing the swab stick on the saline-washed wound and turning it for 180°. The pawpaw-packed wound was covered with gauzes and held with crepe bandage. Wound inspection and dressing were done on alternate day basis. Wound swab was taken at the end of the desloughing and sent for microscopy, culture and

sensitivity. The result was compared with the initial finding for possible antimicrobial clearance.

The data were collected and analyzed with IBM SPSS version 21(IBM Corp. Armonk, NY, USA).The rapidity of slough clearance, antimicrobial clearance, and duration of slough clearance were assessed and findings presented in prose and tables.

The cost of the study was borne by the researchers. There was no grant or funding from any organization or individuals that would affect the study. There was also no conflict of interest.

RESULTS

Thirty patients were enrolled in the study that had slough containing wounds that would traditionally require surgical debridement. The patients were aged between 6months and 80 years. There were 14 females and 16 males with a female to male ratio of 1:1.14. The wounds were of various sizes with mean of 127.13cm². The wound duration varied from 7 d to 260 d which latter was a recurrent leg ulcer (Table 1). The wounds were due to four major aetiologies with trauma being the leading cause (Table 2). There was only one diabetic wound used in the study. Pressure sores constituted 20% of the patients. Eschar separation occurred earliest after 3 d of dressing and latest after 14 d with a mean period of 5.5+ 2.255 days. A case had negative bacterial culture on the first test. Others had a variable period of clearance with maximum of 18 d and mean of 6.73+3.750 days (Table 1).

Table 1: Physiologic parameters of patients and wound response to papaya dressing

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Age	30	.5	80.0	38.050	21.1816
Haematocrit	30	20.0	42.0	31.733	6.4108
Albumin	30	24.3	39.0	32.153	4.3544
Wound size	30	20	500	127.13	103.039
Duration	30	7	260	39.73	49.516
Eschar separation	30	3	14	5.50	2.255
Bacteria clearance	30	0	18	6.73	3.750
Valid N (listwise)	30				

Table 2: Distribution of etiology of ulcers

Variable	Frequency	Percent	Valid Percent	Cumulative Percent
Post traumatic	15	50.0	50.0	50.0
Post infective	8	26.7	26.7	76.7
Diabetic ulcer	1	3.3	3.3	80.0
Pressure sores	6	20.0	20.0	100.0
Total	30	100.0	100.0	

Table 3: Correlations between the wound size and eschar separation time

Variable	Mean(SD)	Pearson correlation	P-value
Wound size, N=30	127.1 (SD 103.04)	.571*	0.001
Eschar separation time	5.50 (SD 2.26)		

Table 4: Correlations between the wound size and bacterial clearance time

Variable	Mean(SD)	Pearson correlation	P-value
Wound size, N=30	127.1 (SD 103.04)	0.375*	0.041
Bacterial clearance time	6.7 (SD 3.75)		

The wound size had a positive correlation with the eschar separation and the bacterial clearance time. The bigger the size of the wound, the longer it took to achieve both eschar separation and bacterial clearance respectively. The *P*-values were 0.001 (Table 3) for the wound size correlation with eschar separation time and 0.041 (Table 4) for the wound size correlation with the bacterial clearance time which was all statistically significant.

There was no allergic reaction observed in any of the thirty patients involved in the research. No other complications were observed.

DISCUSSION

The cost of wound care is huge and demanding clinically, socially and economically especially in the developing countries where the productive age bracket is usually affected by poorly managed post-traumatic ulcers^{3,11}. The lack of health insurance or social packages all the more leaves the patients in a near-abandoned state in these hospitals. Inability to pay for multiple theatre sessions forces the wound caregivers to resort to wound dressing. The goal was to cleanse the wound of sloughs and/or eschars. We employed the use of unripe pawpaw dressing to achieve an earlier wound bed preparation. Although use of negative pressure wound dressing has been found to cause both earlier wound bed preparation and better skin graft take in the long run, it is applicable and preferable in wounds debrided of dead tissues^{12,13}. This is where unripe pawpaw dressing has its unique application.

Different escharotics have been employed to manage different kinds of wounds including normal saline, honey, and hydrogel among others^{14,15}. The use of unripe pawpaw as escharotics in wound bed preparation is promising. The goal of this modality is to achieve faster wound bed preparation and reduce the length of hospital stay. A separation time

of 29.9+ 3.7 d was reported for normal saline and 21.8+5.7 d for honey in a study done on neonates with major omphaloceles¹⁴. An earlier slough separation in burns and post-operative breakdown wounds has been reported in which unripe pawpaw was used as an escharotic^{5,16}.

In our study, we recorded an average eschar separation period of 5.5 d as compared with above 20 d reported by Bode et al. using either normal saline or honey, which are also in common use in our centre¹⁴. The major advantage of this is reduced wound bed preparation period and consequently a reduction in the overall hospital stay. Moreover, for patients who may not be physiologically fit for surgical intervention, this option is most suitable.

Papaya also has a documented antibacterial activity¹⁷. This showed as bacterial clearance mean time of 6.73+ 3.75 d in our study. This wound bacterial clearance time was comparable to that observed in a study using honey which occurred in average period of 7 days¹⁸. This is due to its ability to destroy bio-films allowing the administered systemic antibiotics to affect the organisms^{5,16}. This antibacterial action is considered very essential in the progress of wound healing in addition to the contribution of high level of ascorbic acid in pawpaw fruit for conversion of proline to hydroxyproline enhancing collagen synthesis¹⁶.

With both eschar separation and bacterial clearance, the wound bed is rapidly prepared for ultimate surgical cover. This would in the long run reduce the length of hospital stay.

Other benefits include avoiding the complications of bedside debridement such as pains and bleeding as well as the potential complications and costs of operation room debridement which include the complications of anaesthesia¹⁹. In a resource poor setting where bedside debridement is a traditional practice despite its obvious disadvantages, use of pawpaw dressing would serve a good alternative. The cost of collagenase dressing has been reported

to be cheaper than hydrogel dressing which is a form of autolytic debridement, as are honey and normal saline²⁰. This cheaper cost per wound dressing session in addition to reduced length of hospital stay gives a significant economic and clinical benefit²⁰.

Limitations

There were a few limitations which included a small sample size as well as inability to assess the granulation tissue formation rate. This was not included in the objective; however we observed rapid granulation tissue formation following papaya dressing.

CONCLUSION

Unripe pawpaw demonstrates a significant improvement in this study compared to other escharotics used in other studies. Its ability to both remove eschars and cause bacterial clearance results to faster wound healing. It is in addition a suitable option in patients who are not fit for surgical debridement. We recommend this cheap, readily available and easy to apply agents for use in developing countries with abundance of *Carica papaya*.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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