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

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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±103 cm². 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 mortality. 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 individual. 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 more.

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 biological. 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 stress.

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

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 environment.

The Nigerian pawpaw has been used for a study in animal models with a proven efficacy. 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. 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).

| 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       | 14      | 5.50  | 2.255          |
| Eschar separation | 30 | 0       | 18      | 6.73  | 3.750          |
| Bacteria clearance | 30 | 0      | 18      | 6.73  | 3.750          |
| Valid N (listwise) | 30 |        |         |       |                |

| 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         |                    |
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. 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. This is where unripe pawpaw dressing has its unique application.

Differes escharotics have been employed to manage different kinds of wounds including normal saline, honey, and hydrogel among others. 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 omphaloceles. An earlier slough separation in burns and post-operative breakdown wounds has been reported in which unripe pawpaw was used as an escharotic.

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 centre. 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 activity. 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 $7$ days.

This is due to its ability to destroy bio-films allowing the administered systemic antibiotics to affect the organisms. 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 synthesis.

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 anesthesia. 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 saline. This cheaper cost per wound dressing session in addition to reduced length of hospital stay gives a significant economic and clinical benefit.

**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.

**REFERENCES**

1. Gosselin RA, Spiegel DA, Coughlin Richard, Zirkle LG. Injuries: the neglected burden in developing countries. *Bull World Health Organ* 2009; 87(4):246.

2. Buck D W, Galiano R D. Wound Care. In: Thornes C H et al (Eds). *Grabb and Smith’s Plastic Surgery* (7th ed). Philadelphia, U.S.A, LippincotWilliams and Wilkins; 2007. Pg 20-28.

3. Rahman GA, Adigin IA, Fadeyi A. Epidemiology, etiology, and treatment of chronic leg ulcer: Experience with sixty patients. *Ann Afr Med* 2010; 9:1-4.

4. Manna B, Morrison CA. Wound Debridement. [Updatd 2020 Feb 14]. In: StatPearls[Internet]. Treasure Island (FL): StatPearls Publishing; 2020 Jan-.

5. Jayarajan RC, Narayanan PV, Adenwalla HS. Papaya pulp for enzymatic wound debridement in burns. *Indian J Burns* 2016;24(1): 24-28.

6. Wienert V. *Epidemiology of Leg Ulcers*. In: Hafner J et al (eds). Management of leg ulcers. Basel, Switzerland, Karger AG; 1999: 4-8.

7. Mork F. Cutaneous Ulcers, Sinuses and Fistulae. In: Badoe EA et al (eds). *Principles and Practice of Surgery including Pathology in the Tropics* (4th ed). Accra, Ghana, Assemblies of God Literature Centre Ltd; 2009: 70-82.

8. Sen CK, Roy Sashwati. Wound healing. In: Gurtner GC. Plastic Surgery (3rd ed. Vol.1). USA, Elsevier; 2013:254-255

9. Osunwoke EA, Oladopo OO, Zamide EI, Oladipo GS. A study on some effects of the extracts of unripe pawpaw (*Carica papaya* linn) on wound healing in Wistar rats. *Port Harcourt Med J* 2009;3(3).

10. Wikipedia.org. List of countries by papaya production. https://en.m.wikipedia.org.

11. Sen CK. Human wounds and its burden: Updated compendium of estimates. *Adv Wound Care (New Rochelle)* 14 Feb 2019;8(2):39-48. https://doi.org/10.1089/ wound2019.0946.

12. Maduba CC, Nnadozie UU, Modekwe VI, Nwankwo EU. Comparing hospital stay and patient satisfaction in a resource poor setting using conventional and locally adapted negative pressure wound dressing methods in management of leg ulcers with skin grafts: a comparative prospective study. *Pan Afr Med J* 2020;36:105 [doi:10.11604/ pamj.2020.36.105.19961]

13. Maduba CC, Nnadozie UU, Modekwe VI, Onah II. Split Skin Graft take in leg ulcers: Conventional Versus Locally adapted negative pressure dressing. *J Surg Res* 2020;251:296-302. https://doi.org/10.1016/j.jss.2020.01.029.

14. Bode CO, Ademuyiwa AO, Elebute OA. Formal saline versus honey as escharotics in the conservative management of major omphaloceles. *Nigerian Postgraduate Medical Journal* 2018;25(1):48-51

15. Milne CT, Ciccarelli AO, Lassy M. A comparison of collagenase to hydrogel dressing in wound debridement. *Wounds* 2010;22(11).

16. Murthy MB, Murthy BK, Bhave S. Comparison of safety and efficacy of papaya dressing with hydrogen peroxide solution on wound bed preparation in patients with gape wound. *Ind J Pharm* 2012;44(6):784-787

17. Emeruwa AC. Antibacterial substance from *Carica papaya* fruit extract. *J Nat Prod* 1982;45(2):123-127

18. Biglari B, vd Linden PH, Simon A, Aytac S, Gerner HJ, Moghaddam A. Use of medihoney as a non-surgical therapy for enzymatic debridement of pressure ulcers. *Indian J Burns* 2010;44(6):784-787

19. Carpenter S, Shaffett TP. Choosing the best debridement modality to battle necrotic tissue: Pros & Cons. *Today’s Wound Clinic* 2017;11(7).

20. Waycaster C, Milne CT. Clinical and economic benefit of enzymatic debridement of pressure ulcers compared to autolytic debridement with a hydrogel dressing. *J Med Econ* 2013; 16(7)976-986. https://doi.org/10.3111/13696998.2013.807268.