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Role of Foam Dressings in Healing of Wounds in Comparison to Conventional Methods.

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A B S T R A C T

Background: The management of wounds is a significant healthcare burden associated with large expenditures. Foam dressings are said to be a better and economical in exudating wound healing compared to other conventional dressings.The purpose of this study is to evaluate the evidence for the effectiveness of foam dressings compared to other regularly used dressings.***Methods***: 100 patients with exudative wounds were selected and divided into 2 groups. One treated with conventional dressings and the second with foam dressings. The objectives are reduction of exudate, bacterial growth, development of granulation tissue and finally the split skin graft uptake. ***Results***: The foam dressings show better results in reduction of exudate, bacterial growth and development of the granulation tissue with no difference in the graft uptake. It is found to be economical and comfortable to the patient. ***Conclusion***: The foam dressings show better results compared to conventional dressings and are advisable for patients with exudative wounds.

Keywords: Foam dressings – FD, Conventional dressings – CD.

INTRODUCTION

A chroniculcer is a major health problem. It incurs a lot of financial, social and mental burden for the patient and his family. The health care financial burden of wound care management is massive, andis increasing with the aging population. Up to $28 billion dollars in American Medicare spending is allocated to chronic wounds annually [1]. The management of wounds is a long-standing challenge to health care professionals. This challengemade the clinicians to look for newer methods of wound healing, which reduces the economic burden on the health care system and optimal utilization of the limited resources available. The management of wound care have undergone a multiple changes with advent of time and yet none proved superior to the other. Surgeons are continuously testingnewer methods to achieve better healing or lessen the preparation time for wound closure. Wound healing depend on multiple factors like 1) bacterial factors like load, virulence and resistant bacteria. 2) Local factors– clean or unclean wound, amount of exudate, slough and foreign body. 3) Patient factors - Extremes of age, Immunosuppression, Malignancy, Renal diseases, Diabetes Mellitus, Malnutrition, and Cigarette Smoking. Wound care includes control of different factors associated with wound healing, and the local wound dressing plays an important role. 3 stages of wound healing are inflammation, granulation and maturation. In the inflammation stage, exudate accumulates in the wound bed due to increased capillary

permeability. The cytokines, growth factors, plasma components, proteases and protease inhibitors in the exudate help to promote tissue debridement. Exudates in the chronic ulcers prevent the proliferation of fibroblasts, keratinocytes and endothelial cells, while exudate from active ulcers stimulate their proliferation. The management of the exudate in Chronic wound has an important role in the progression from the inflammatory stage to the granulation stage. The pathology of wound healing and it's research is complex. The better wound healing depends on the principal of a moist wound environment. The concept of moist wound healing was concieved in the 1960s, and a wide variety of wound dressings were developed and used [2, 3]. These methods include foams, hydrogels, various debriding agents, alginates and topical antimicrobial dressings. These dressings have achieved remarkable outcomes, but still there is a need forbetter methods to hasten wound healing or preparation time. The cost of each dressings differ. To optimize health care benifit, it is necessary to carefully evaluate the efficacy of different wound dressings combined with cost-benefit analysis [4]. Different types of dressings are in use since a long time.

Non-adherent Dressings: Nonadherent dressings containparaffin, petroleum jelly, and water-soluble jelly like materials.They need a secondary dressingto seal the edges which prevents infection and desiccation. Examples include BACTIGRAS and SOFRATULLE. **Occlusive and Semiocclusive Dressings:** Occlusive and semiocclusive dressings are used in aclean, minimally exudative wounds. They are waterproofbut permeable to water vapor and oxygen. They include TEGADERM, OPSITE FLEXIGRID. **Absorbent Dressings:** These dressing helpabsorbing the exudates from the wound and include cotton, wool, and sponge. **Hydrocolloid and Hydrogel Dressings:** Hydrocolloid and hydrogel dressings combine the benefits of occlusion and exudate absorbption. Hydrogels allow evaporation without affecting wound hydration, thus makes them usefulinburn wounds. **Alginates** contain polysaccharides of mannuronic and glucuronic acid. The polymers gel will absorb lot of fluid and smell. Alginates are used when in open surgical wounds withskin loss, and medium exudation, **Medicated Dressings:** Medicated dressings used as a drug-delivery system containing Zinc oxide, Neomycin, and Bacitracin-Zinc. A high exudative wound requires absorbent dressings with these dressings. **Mechanical Devices:** Mechanical therapy augments and improves the absorption of exudates and control of odor. The vacuum-assisted closure (VAC) system assists in wound closure by applying localized negative pressure to the surface and margins of the wound. The negative-pressure wound therapy (NPWT) is applied to a special foam dressing cut to the size of the wound and positioned in the ulcer bed. The continuous negative pressure is extremely effective in removing exudates from the wound. This form of dressing has been found to be most effective types for chronic open wounds, but this mode of treatment needs a lot of equipment and costly. **Foam dressings (FD):**Foam is made of air-filled spaces within a solid polymer matrix. FD porous structure absorbs exudates into these air-filled spaces by capillary action. Polyurethane is the mostcommon used foam dressing. They also provide excellent cushioning and impact resistance. Wounds which produce excess exudate has the risk of peri-wound skin maceration. Wound dressings need to be absorbent in highly exudative wounds so that the wound environment is moist rather than wet to avoid maceration. FD are an effective tool for moist wound care. They are useful in managing exudative wounds in preventing dressing related trauma, and minimizing pain and discomfort [5]. Foam dressings are manufactured from either semi permeable polyurethane or silicone foam and are available as sheets (with and without integrated adhesives) or cavity-filling chips. They are better for absorbing excessive amounts of exudates, create a better wound healing environment. They provide good protection in the form of padding, and are generally occlusive, thus not requiring additional overlying dressing. Moreover, under most circumstances, they can be left in place for 2 to 3 days at a time, reducing the cost and discomfort of frequent dressing changes.

Objectives

The study aims to compare the efficacy of Foam dressings(FD) withConventional wound dressings (CD) in exudative wounds in terms of1) the time required for the development of healthy granulation tissue in ulcer bed, 2) quality of skin graft uptake3) cost-effectiveness of the both methods.

MATERIALS

The "Role of foam dressings in healing of wounds in comparison to conventional dressings" is a prospective observational study.Patients with ulcers of different etiology admitted to Department of General Surgery in Dr Pinnamaneni Siddhartha Institute of Medical Sciences & Research Foundation, a tetiary care hospital from january 2022 to December 2023 were included. 100 cases were studied during this period. All the subjects are explained about the procedure, management methods, and were included in the study with their willingness. They were divided in to 2 groups. 50 patients were in control group with regular dressings, other 50 patients were dressed with Foam dressings. A clearance from the ethical committee was taken.

Inclusion criteria: All exudative ulcers of different aetiology.
All ulcers which are completely debrided and free of slough.

Exclusion criteria: Patients with dry, non-exudative ulcers.
Patients with vascular, and neurogenic ulcers.

Patientswith Immuno deficiency status like HIV.

METHODS

The wounds are debrided either bedside or in the operation theatre under local, regional or general anesthesia. The co-morbid conditions of diabetes, hypertension, infection are controlled with respective treatment modalities. Patients of both groups are administered culture and sensitivity specific i.v. antibiotics. In the FD group, industrial-grade foam (non-medicated polyurethane) is used as the dressing material. The wounds were initially cleaned with normal saline solution, bedside debridement done if necessary. A sterilised polyurethane foam sheet was cut to fit the size and shape of the ulcer, immersed in sterile saline and then manually squeezed to drain as much saline as possible. This procedure was completed to make the foam more conformable. The foam sheet was then appliedto the wound bed. Sterile gamgee pads were placed on it and held in place with gauze bandage. No topical antibiotics, de-sloughing ointments, or other agents were used in the study group. In the CD group, patients underwent surgical debridement in the operating room and the wounds were dressed regularlywith conventional techniques using topical antibiotics, de-sloughing agents (e.g., betadine, hydrogen peroxide, etc.), depending on the status of the wound. The progression of ulcer, the days for the granulation tissue to develop, the patient factors like pain and discomfort, the cost of the dressings, the duration of hospital stay and the outcome are assessed and analyzed.Split skin grafting (SSG) is done in the FD andCD groups when the ulcer developed healthy granulation tissue. The end-point was the number of days from the time of final debridement (start of granulation tissue growth) to the time of the SSG. The graft uptake and postoperative period are compared in both the groups and analyzed. Analytical data obtained were compared and discussed with the data available in the literature.

RESULTS

1) Age Distribution:

Age group is divided with the interval of 10. There is a comparable difference between the two groupsconcerning age as the p-value is 0.042 which is less than 0.05.

Age	CD	FD	Total	p value
21-30	5	2	7	0.042
31-40	3	4	7	
41-50	8	6	14	
51-60	18	15	33	
>60	16	23	34	
Total	**50**	**50**	**100**	

2. SEX DISTRIBUTION:

In the conventional group, 36 males and 14 females are there, and in foam dressing group there are 42 males and 8 females. The p-value is 0.148 which means there is no significant difference between the two groups and they can be comparable.

Gender	CD	FD	Total	p-value
Male	36	42	78	0.148
Female	14	8	22	
Total	**50**	**50**	**100**	

3. Ulcer parameters: All the ulcer parameters are compared between the study and control groups.

Parameter	CD		FD		p value
	Mean	SD	Mean	SD	
Onset	1.76	0.431	1.66	0.479	0.275
Size(cm2)	81.820	58.023	105.58	101.46	0.552
Edge	1.08	0.274	1.04	0.198	0.405
Base	1.7	0.463	1.92	0.27	0.367
Floor	1.38	0.49	1.34	0.478	0.681

The above parameters like onset, size in cm^2, edge, base, and floor of the ulcer are compared and analyzed between the two groups. This is showing no significant difference between the two groups. Hence the two groups can be taken for output analysis so that the analysis will be reliable.

4. Bacterial load:

Ulcer is being dressed with the two agents accordingly in the respective groups and the bacterial load i.e. positive culture and sensitivity of the swab taken from the ulcer site when planning for grafting.

Parameter		CD	FD	Total
Bacterial load	No growth	19	41	60
	Growth +	31	9	40
Total		50	50	100

Parameter	Measures	CD	FD	p value
Bacterial Load	Mean	1.62	1.18	<0.0001
	SD	0.49	0.054	

Here the p-value is less than 0.05, which denotes that there is a significant difference between the bacterial load. The ulcer with foam dressing is having less bacterial contamination as it sucks the bacteria from ulcer surface by capillary action which a conventional gauze dressing could not accomplish.

5. Use and cost-benefit analysis:

Both the groups are compared based on the comfort and cost-benefit of the patient with FD and conventional dressing. The patient's comfort is assessed based on the pain according to VAS (visual analog scale) which is rated from 1-10. VAS >5 is painful. The effective amount (in rupees) spent on both the dressings.

Parameter		CD	FD	Total
Use& cost Benefit	Painful & costly	49	12	61
	Less pain &cost	1	38	39
Total		50	50	100

	Measures	CD	FD	p value
Use and cost	Mean	1.02	1.76	0.02
	SD	0.14	0.43	

The above comparative table with p-value 0.02 shows that there is a significant difference in comfort and cost benefit between the two groups and foam dressing is far better than conventional gauze dressing.

6. Number of days for granulation:

The days required for the granulation tissue to develop on the ulcer is compared between the two groups.

Parameter	Measures	CD	FD	p value
Number Of days for granulation growth	Mean	11.2	9.4	0.009
	SD	3.39	3.38	

The above table with p-value 0.009 which is less than 0.05 showthat there is a difference that is significant enough to consider foam dressing is a better alternative.

7. Graft uptake:

The ulcer which is ready for grafting is taken up under anesthesia and followed till it heals. The graft dressing is done on 3rd, 5th, 7th, and 10th post op days and assessed for the graft uptake. Graft uptake is estimated in percentage by taking healthy area of the graft by total graft area. The healthy area is measured by color (normal colour without blackening) of the graft, adhesion between graft and bed (good adherence)

Parameter	Measures	CD	FD	p-value
Graft Uptake	Mean	95.2	96.6	0.19
	SD	5.7	4.994	

The above table and picture are showing the graft uptake between the two groups, and the p-value is more than 0.05 which denotes that there is no significant difference between the two groups.

8. Postoperative period:

The postoperative period is assessed for complication like graft infection. If there is foul smelling discharge and pus from the grafted area it is regarded as post-op infection and otherwise labeled as an uneventfulpost-op period.

Parameter		CD	FD	Total
Post OP period	Uneventful	42	46	88
	Infection	8	4	12
Post op period	Mean	1.16	1.08	0.22
	SD	0.37	0.27	

DISCUSSION

The wound management is a complex process. It consumes a lot of patient's time, resources with loss of work and income. It is also a burden on the health care system and the individual's family. This scenario is worse in India with a major low socio-economic population with poor resources and a limited health care facility. In this scenario an economical and low-cost dressings which can give better or equivalent results with regular dressings is a need. One such is foam dressings which is cheaper than conventional dressings. A study "Role of foam dressing in wound healing in comparison with conventional methods" was conducted in Dr. Pinnamaneni Siddhartha Institute of Medical Sciences & Research Foundation, from January 2022 to December 2023. Two groups with 50 patients each with exudative wounds are studied and compared. It was conducted to study the efficacy of foam dressings in terms of easiness, comfort, economy to the patient. It also studies the efficacy in reduction of exudate, infection, time to development of healthy granulation tissue and finally a graft uptake in view of the surgeon.

There is no significant difference in age, sex, and the parameters of the ulcers (Tables 1, 2 & 3).

This study shows a significant reduction of bacterial load and growth in foam dressing group compared to conventional dressings (Table 4). It also shows enhanced and significant development of granulation tissue in the FDgroup compared to CD group (Table 6). The graft uptake shows no significant difference in both groups (Table 7). It shows a significant comfort and cost effectiveness to the patient (Table 5). No significant post operative complications noted (Table 8).

The amount of wound exudate, the state of the wound bed, the phase of wound healing, host resistance and bacterial load, all play a crucial role in considering the most appropriate dressing material to be used in infected wounds. Total absorption of wound exudate is the primary function of the foam dressing. This absorption capacity of the FD needs to match with the amount of the wound exudate. The stage of wound healing influences the amount of exudate. The selection of a good dressing is based on the amount of exudate. The FD should prevent the drying-out of the ulcer or maceration of the peri wound skin [5]. Foam dressings fulfil the Tuner criteria for ideal wound dressing. They help to maintain moisture in the wound bed. Simple to apply and to remove. FD protect the skin around the wound. Protecting the wound against the entry of outside bacteria and maintaining temperature. They are non-toxic, non-allergic with good cushioning effect giving mechanical protection against external injuries, and conform to shape of the body. Easy to use; and economical and having a long shelf life [6]. Enrique Salmeron-Gonzalez *et al*., found that FDs showed a higher absorption of exudates than hydrofibers, alginates, and hydrocolloids while using on a similar surface of the dressing. A modification of size of the dressing after saturation was observed, increasing its size in the case of foams and decreasing or maintaining it in the case of alginates, hydrofibers, and hydrocolloids. This study shows a better results in wound exudate management with FD. However, when deciding which dressing to use for a specific wound, absorption capacity is not the only quality that should be taken into account, as other properties should also be considered [7].Self-adhesive Foam dressings are less traumatic to the skin while acrylic adhesive used in hydrocolloid dressings more traumatic [8]. A study by Shastri R. K, *et al*., found foam dressings are significantly easier to use than a gauze dressing. The difficulty at removal may cause trauma to the wound and surrounding skin with reduced quality of life, wound-related pain and delayed healing. Foam dressing are less painful at dressing change. The proportion of patients experiencing pain-free dressing removal is 82% in the FD group and 44% in the group treated with the conventional gauze dressing. In this series, removal of dressing was easy in 88.3% of cases in the FD group compared to 43.8% in the CD group [9]. In our study, the ease of use and cost-benefit analysis between the two groups are compared, and 98% of patients in conventional group and 24% patients in foam group experienced pain and dressing being cost-effective. The p-value for the comparison is 0.02 which signifies that there is a significantdifference in the use and cost benefit between the 2 groups indicating that the FD is better in use and cost-effectiveness.Nielson and Fogh, concluded that the efficacy of foam products over other wound dressings is limited. In daily practice, FDs are easy to use and match the ideal criteria for a dressings moist wound healing [5]. In our study the result implies that foam dressing is patient friendly in use and it enhances early recovery. Thus fulfilling the ideal criteria a patient friendly dressing for wound healing. In a study done by Ajit Kumar Varma*et al*., the mean number of days taken for healing of wound in the study group was 22.5 ± 15.4 days (24/24 patients), while in the control group it was 52.0 ± 22.7 days (17/24 patients, $P< 0.0001$). The Kaplan-Meier graph in their study suggested the median time to wound healing was 16 days in the study group and 60 days incontrol group [10]. In our study wounds took a mean of 11.2 days in the gauze group compared to 9.4 days in the FD group to achieve full granulation. There may be a difference in the wound size between the two groups and hence the difference in mean no of days for the granulation to develop. In a study done by Jo C Dumville, Sohan Deshpande, *et al*., the results are as

follows: it included 6 studies of 157 participants in the review. Meta-analysis of two studies has demonstrated that foam dressings do not promote healing of diabetic foot ulcers in comparisonwith basic wound contact dressings (RR 2.03, 95% CI 0.91 to 4.55). Data from two studies comparing foam and alginate dressing found no significant difference in ulcer healing (RR 1.05, 95% CI 0.92 to 2.44). There was no difference in the number of diabetic foot ulcers healed when foam dressings were compared with hydrocolloid dressings. The drawback of these studies are small and had limited follow up times [11].Nielson and Fogh, concluded that the advantage of the use of foam products over other wound dressings is limited. FDs are easy to use and is a better dressing in moist wound healing [5]. In our study, the result implies that foam dressing is patient friendly in use and it enhances early recovery. Thus fulling the ideal criteria for wound healing. JinWon Lee and Kyo Young Songin their animal studies on rats concluded that Betafoam (polyurethane foam dressing impregnated with 3% povidone-iodine) is effective in ulcer healing and provides the best performance amongst the different types of dressing materials in terms of re-epithelialization, angiogenesis, collagen deposition, and tissue invasion [12]. A Perssonconcluded that the presence of foam dressings in Pseudomonas aeruginosa cultures caused an altered environment for the bacteria due to reduction of pyocyanin which is visualized as a change in color from green to yellow. This indicates that the virulence of the bacteria is reduced with polyurethane foam dressings [13]. Poly Urathane foams dressings are a useful inclusion in modern wound care management formularies as they possess a wide range of properties including non-adherence, the ability to convey medicaments, to be cut to shape, to provide thermal insulation, gas-permeability, maintenance of the moist environment and are light and comfortable to wear. Their value in terms of outcomes lies in accurate assessment together with having realistic expectations in their performance. We must realise that the dressings alone do not heal wound [14].

CONCLUSION

The comparitive study of Foam dressings Vs conventional dressingsat our institute, DR PSIMS & RF, shows better results in favour of Foam dressings in moist wound managemnt over conventional dressings. Foam dressings in wound care has advantages of their ease of use, relatively low cost. Overall, foam dressings are better tools in moist wound care. In practice, they are simple to use and patient acceptance is higher than other dressings. FDs helps in early development of healthy granulation tissue and thus early closure of wound. It is economical compared to conventional dressings. Though economically rich countries stopped this mode of dressings, it is advocated in developing countries.

Conflict of Interest: No conflict

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