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Effect of Nutritional Factor on Burn Wound Healing for burned patients

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Abstract

Background: Nutrition is crucial factor in maintaining burn Healing of burn wounds Excessive energy demands during the burn wound healing process should be met with proper nutrition. Nutritional deficits obstruct the natural processes that allow wound healing to go through particular stages. **Aim:** To assess the effect of nutritional factor on burn wound healing. **Research question:** Does the nutritional factor affect on burn wound healing? **Methods:** A convenience sample of thirty adult patients who admitted to the burn unit at Assiut and El Elman General Hospitals. **Tools:** (I) Patient assessment sheet. (II) The Bates-Jensen Wound Assessment Tool (BWAT). **Results:** A negative relationship was found between burn wound severity and clinical nutritional parameters as good nutrition, hemoglobin, fluid, calories and protein intake (-0.664,-0.579,-0.621, -0.752, -0.777 respectively). **Conclusions**: A deterioration in burn wound condition from minimal to moderate and extreme severity was observed among studied patients with reduction of nutritional parameters. **Recommendation:** Nutritional elements must be provided for burned patients during all phases of burn wound healing process.

Keywords: Burn, Nutritional factors & Wound healing.

Introduction

Nutrition has been known as a critical role in burn wound healing for more than a century. Hypermetabolism and negative catabolism are common in burned patients. The most visible effect of hunger or specific dietary shortages on wound healing after trauma and surgery is malnutrition. Special nutrients are typically required by patients with chronic or non-healing wounds who are also nutritionally deficient. The healing process is influenced by energy, carbohydrate, protein, fat, vitamin, and mineral metabolism **(Guo & Dipietro, 2010; Clark et al., 2017).**

Many body systems can be affected if a significant portion of the body (30% or more) has been burned as a result of cardiovascular, respiratory, metabolic, and immunological abnormalities. Cytokines and other inflammatory mediators circulate throughout the body, causing changes. Increased capillary permeability, reduced cardiac contractility, and hypotension can all affect the cardiovascular system. Inflammation, hypermetabolism, muscle wasting, and insulin resistance are all hallmarks of the pathophysiological response to severe burns **(Jeschkek et al., 2020).**

When a thermal injury occurs, the wound is divided into three zones. The coagulation zone, the stasis zone, and the hyperemia zone. The coagulation zone is made up of cells that were injured during the injury and are now in a condition of coagulated necrosis. The zone of stasis, which surrounds the coagulated region, is inflamed and has reduced perfusion. Tissue in this zone may survive the insult or move to coagulative necrosis, often within 48 hours of the initial lesion, depending on the type of the wound. The zone of hyperemia, which is characterised by vasodilation as a result of the inflammation surrounding the burn damage, is the final area. Tissue in this area is still alive and usually is not subjected to advancing necrosis (**Ball et al., 2020).**

Wound healing is influenced by nutrition, which is an important part of the overall healing process. The most visible effect of hunger or specific dietary shortages on wound healing after trauma and surgery is malnutrition. Special nutrients are typically required by patients with chronic or non-healing wounds who are also nutritionally deficient. Energy, carbohydrate, protein, fat, vitamin, and mineral metabolism; all can affect the healing process **(Quain & Khardori., 2015).**

Nurses play a significant role in understanding the importance of basic nutrition and needs; delivering healthy diet education and informing patients about the benefits of making healthy eating choices. The nurse's role in initial nutrition screening is crucial to identify patients who are already malnourished or at

risk of becoming so and further develop nutritional care strategies to prevent severe malnutrition **(Xiaoyue et al., 2017).**

Significance of the study:

Based on the researcher's clinical experience as a nursing supervisor in burn unit, it has been observed that many burned patients can expose to various problems in healing of their wound. Many factors can lead to these problems, one of these factors is the nutrition so, in this study the researcher handled in depth this factor to explore its effect on burn wound healing.

Aim of the study:

To assess the effect of nutritional factor on burn wound healing for burned patients.

Research question:

Does the nutritional factor affect on burn wound healing?

Operational definition:

Healing of burn wound: It refers to the healing process of the burn wound (formation of epithelial tissue) within three weeks from burn injury.

Patients and Methods

Design of the study

A descriptive exploratory research design.

Setting:

The research was carried out in Burn Unit at Assiut General Hospital & El Eman General hospital.

Sample:

A convenience sample of thirty adult patients with second degree burn (superficial and deep), less than 35% burn percentage, within a period of 6 months, both sexes, and their ages ranged from 18 to 65 years old, and willing to take part in the research. Patients with inhalation injuries and associated injuries are excluded from the study.

The study tools:

There were two tools used to get the necessary information for the study.

Tool (I): Patient assessment sheet:

The research created this sheet based on literatures review **(Smeltzer et al. 2018)** to assess patient's condition. It was divided into three sections:

Section (1): Demographic data: It was created to examine demographic features of the patients such as (age, gender, marital status, educational level, and occupation).

Section (2): Clinical information: It was developed to assess the patients' clinical data as (causes of burn, degree of burn, percent of burn, and past medical history).

Section (3): Nutritional assessment:

It was developed by researcher to assess patients' nutritional status by using standardized nutritional assessment tools as:

1. Body mass index, triceps skin fold thickness, midarm and muscle in the arm circumferences and other anthropometric measurements
2. Biochemical measurements (liver function testes, complete blood picture, electrolytes levels and renal function testes (urea and creatinine).
3. Clinical examination findings e.g (oral examination and assessment of skin turgor, edema, elasticity, dryness and other factors are assessed.
4. Dietary management (fluid therapy, calories and protein).

Tool (II): Bates-Jensen Wound Assessment Tool (BWAT)

Bates-Jensen & Sussman (2007) created a valid and trustworthy tool; It was adopted in this study to monitor healing of burn wound after admission and then once each week until third week. It consists of 13 items (size, depth, edges ,undermining, necrotic tissue type, necrotic tissue amount, exudate type, exudate amount, skin color, edoema, induration, granulation, and epitheliazation).

Scoring system:

Each item on the scale is rated from 1 to 5; with1 being the best condition and 5 indicates worst condition characteristic. The total BWAT is the sum of the 13 components. Which is ranged from 13 to 65. The BWAT scores are classified into four severity groups (13–20 = minimal severity, 21–30 = mild severity, 31–40 = moderate severity and 41–65 = extreme severity).

Methods

Validity of content:

It was formed by panel of five expertise (3 members staff of the Medical Surgical Nursing teaching faculty and 2 from Medical staff of plastic surgery) who checked the tools for clarity, and applicability, comprehensiveness, understanding, applicability and easiness, minor adjustments were required for convenience and ease of use. The internal consistency of the tools was examined using cronbachs alpha=0.88 to determine their reliability.

Pilot study:

To assess the clarity, feasibility, and usefulness of the tools, a pilot study was done on 10% of patients in the chosen setting. The data obtained from the pilot study were analyzed, no change was done in the tools so, the sample of the pilot study included in the main study.

Ethical consideration

The head of the department granted formal authorization of El Eman General Hospital and General Assiut Hospital. Patients' verbal consent for

voluntary participation was sought, as well as an explanation of the study's nature and objective. Patients had the right to decline to participate in the study and to withdraw at any time.

Procedure:

- Before starting data collection, an official letter was issued from the dean of Faculty of Nursing, and from the managers of El Eman General Hospital and Assiut General Hospital
- The information was gathered between the dates of 1/12/2020 to 30/2/2020 in Assiut General Hospital and 1/7/2020 to 30/9/2020 in El Eman General Hospital.
- The researcher presented herself at the initial interview in order to establish a line of contact and assist the execution of the instruments.
- Data were collected from burns unit in the morning, after noon, and night shifts
- During admission, all patients were given an initial evaluation baseline data via means of toolIand toolII.
- The researcher assessed the nutritional status as follow: as regard anthropometric measurements: Body weight was measured on admission and once each week until 3rd week. The average reading was determined as well. Each participant was instructed to remove heavy clothing and shoes while wearing light clothing and removing heavy things.
- The height was measured on admission and once each week until the 3rdweek after admission by means of a stadiometer. Each patient was instructed to stand completely erect against the wall, with their heads held in a neutral position. Straight forward when the heels are in touch with the wall and had been measurement read and recorded.
- Each patient's BMI was calculated by dividing their weight by their height. The body weight (in kilograms) by the square of the height
- Mid arm circumference (MAC) was measured on admission and once each week until the 3rd week by using a flexible tape which is placed mid-way between the top of the acromial process of the scapula and the ulna's olecranon process; The measurement is recorded in centimeters.
- Mid arm muscle circumference (MAMC) provides information about protein-calorie malnutrition. The calculation for circumference of mid-arm muscle is as follows: MAMC (cm) = MAC (cm)-{0.314XTSF (mm)}
- The thickness of the triceps skin fold (TSF) indicates fat stores. It was measured on admission and once each week until the 3rd week after admission by using calipers. The midpoint of the arm is located; this is the midpoint between the scapula's acromial process (at the humerus's apex) and the ulna's olecranon process (elbow). With the arm at the side, dangling freely, a double fold of skin (not muscle) is grasped by the calipers. The measurement is recorded in millimeters.
- As regard to biochemical measurements: Liver function tests, complete blood picture, electrolytes levels and renal function tests (urea and creatinine) were measured on admission and once each week until third week.
- As regard to clinical examination findings e.g. (Oral examination and assessment of skin turgor, edoema, elasticity, dryness, subcutaneous tone, and wounds and ulcers that are not healing properly) were measured on admission and once each week until third week.
- As regard to dietary management: Fluid therapy, calories and protein requirements for burned patients were calculated according the following formula: **(Natarajan and Sekhar, 2015)**.
  - Maintenance fluid therapy after the initial 48 hours: (25ml x wt. kg) + (40ml x %TBSA) + (wt. kg x%TBSA).
  - Calories: 25kcal/kg actual BW + 40kcal/%TBSA burn.
  - Proteins: 1.5-2 g/kg in adults.
- Burn wound was assessed by researcher on admission, 1st, 2nd and 3rd week by using BWAT scale.

Analytical statistics:

The SPSS computer programme "version 23.0" was used for data entry and statistical analysis.The data were tested for normality using the Anderson – Darling test and for homogeneity variances prior to further statistical analysis. Categorical variables were described by number and percent (N. & %). Continuous variables described by mean and standard deviation (Mean, SD) chi square test used to compare between categorical variables. T- Test used to compare between continuous variables. A person's correlation is used for the numeric variable. $P \leq 0.05$ as a cut off for significance.

Results:

Table (1): Frequency distribution for demographic data among studied patients (n=30)

Demographic data	N	%
Age by years	36.63±9.012	
Sex		
Male	22	73.3
Female	8	26.7
Marital status		
Single	8	26.7
Married	22	73.3
Education level		
Illiterate	8	26.7
Read and write	10	33.3
Secondary school	8	26.7
University	4	13.3
Occupation		
Office work	4	13.33
Farmer	6	20.0
Student	1	3.33
Machinery work	4	13.33
House wife	6	20.0
Not work	9	30.0

Table (2): Frequency distribution for clinical data among the studied patients (n=30)

Chronic diseases	N	%
Diabetes	6	20.0
Hypertension	5	16.7
Causes of burn		
Dry Thermal burn	25	83.3
Moist Thermal burn	5	16.7
Degree of burn		
Second degree (superficial)	5	16.7
Second degree (deep)	2	6.7
Mixed	23	76.6
Percent	24.66±5.40	

Table (3): Comparison between different times of patients' assessment during hospitalization period regarding their anthropometric and biochemical measurements.

Measurements	Admission mean±SD	1St week mean±SD	2nd week mean±SD	3rd week mean±SD	F	P-value
Mid- arm circumference (MAC)	29.20±6.27	29.16±6.33	28.93±6.40	20.23±14.69	51.09	0.001**
Mid arm muscle circumference (MAMC)	22.01±5.03	21.95±5.08	21.73±5.17	15.07±11.09	51.65	0.001**
Triceps skin fold thickness (TSF)	23.01±7.60	23.01±7.60	22.85±7.68	15.80±12.75	31.53	0.001**
Body mass index (BMI)	27.86±5.45	27.80±5.52	27.48±5.60	19.40±13.89	49.58	0.001**
Blood picture						
WBCs	13.29±6.96	12.44±5.83	9.28±3.38	9.32±2.60	3.838	0.006**
HB	14.14±2.24	13.82±1.95	12.14±1.33	11.56±1.47	10.843	0.001**
HCT	41.24±6.82	39.40±6.14	35.35±4.35	34.03±4.35	8.091	0.001**

One way a nova test *** significant P<0.01*

Table (4): Comparison between dietary management parameters during the different times assessment.

Variables	Item	On admission		1st weeks		2nd weeks		3rd week		X2 & P-value
		N.	%	N.	%	N.	%	N.	%	
Fluid therapy	Not taken	0	0.0	0	0.0	0	0.0	8	26.7	48.111 0.001**
	Below	29	96.7	18	60.0	15	50.0	10	33.3	
	Normal	1	3.3	9	30.0	8	26.7	7	23.3	
	Above	0	0.0	3	10.0	7	23.3	5	16.7	
	Means ±SD	4556.66±6765.7		4165.00±1222.43		4290.00±1358.58		4586.36±1698.82		.968ns0
Calories	Not taken	0	0.0	0	0.0	0	0.0	8	26.7	53.514 0.001**
	Below	29	6.7	21	70.0	12	40.0	9	30.0	
	Normal	1	3.3	5	16.7	10	33.3	6	20.0	
	Above	0	0.0	4	13.3	8	26.7	7	23.3	
	Means ±SD	1296.83±593.68		2214.00±828.88		2214.00±828.88		2950.00±1098.80		0.001**
Protein intake	Not taken	0	0.0	0	0.0	0	0.0	8	26.7	60.203 0.001**
	Below	30	100.0	18	60.0	10	33.3	10	33.3	
	Normal	0	0.0	7	23.3	8	26.7	4	13.3	
	Above	0	0.0	5	16.7	12	40.0	8	26.7	
	Means ±SD	51.52±25.36		96.49 ± 49.40		126.96 ± 73.25		143.86±104.55		0.001**

Independent sample T.Test *Ns: not significant p>0.05* *** Significant p<0.01*

Table (5): Distribution of burn wound severity according to Bates Jensen tool among studied patients during different times of assessment (n=30)

Wound severity	on admission		1st week		2nd week		3rd week		Chi-Square	P-Value
	N.	%	N.	%	N.	%	N.	%		
Minimal	20	66.7	12	40.0	0	0.0	0	0.0	74.638	0.001**
Mild	10	33.3	17	56.7	18	60.0	16	53.33		
Moderate	0	0.0	1	3.3	11	36.7	13	43.33		
Extreme	0	0.0	0	0.0	1	3.3	1	3.33		

One way anova *** = Significant p <0.01*

Table (6): Relation between clinical parameters and wound burn wound severity.

Clinical parameters	Test	Burn Wound severity			
		Admission	Correlation		
			1St week	2nd week	3rd week
Good nutrition	**R.**	-0.271	-0.537**	-0.537**	-0.664**
	Sig.	.1470	**.0030**	**.0030**	**.0010**
Poor nutrition	**R.**	.2540	.521**0	.521**0	.592**0
	Sig.	.1760	**.0030**	**.0030**	**.0040**
Lab. investigation					
WBC	**R.**	.1770	.2520	.0560	.0530
	Sig.	.3490	.1790	.7670	.8160
RBC	**R.**	.1580	.2180	.0210	-0.431*
	Sig.	.4120	0.248	0.914	**.0450**
HG	**R.**	-0.196	0.179	-0.304	-0.579**
	Sig.	.2980	0.344	0.102	**.0050**
Hct	**R.**	-0.127	-0.011	-0.323	-0.549**
	Sig.	.5120	.9560	0.082	**.0080**
Fluid intake	**R.**	-0.009	-0.138	-0.402*	-0.621**
	Sig.	.9640	.4660	**.0280**	**.0020**
Calories intake	**R.**	-0.104	-0.281	-0.513**	-0.752**
	Sig.	0.585	.1330	**.0040**	**.0000**
Protein intake	**R.**	.1180	-0.176	-0.560**	-0.777**
	Sig.	0.533	.3520	**.0010**	**.0000**

***Correlation is significant at the 0.01 level (2-tailed)*

**Correlation is significant at the 0.05 level (2-tailed)*

Table (1): Reveals that; the average age of the participants in the study was (36.63±9.015), the highest percentage of them was married (73.3%), read and write (33.3%), and unemployed (30%).

Table (2): Clarifies that; the greatest proportion of those who were studied; had been exposed to dry heat as a cause of burn (83.3%) and the degree of burn was mixed (76.6%). The mean percent of burn wound for the studied patient was 24.66±5.40.

Table (3): Shows that; statistical significant differences were found between different times of patients' assessment during hospitalization period (admission, 1st week, 2nd week and 3rd week) regarding their anthropometric measurements ($p<0.01$) and Biochemical measurements (WBC, HB, HCT $p<0.01$).

Table (4): Statistical significant differences were found in the dietary management parameters (fluid, calories and protein) at different times of assessment ($p<0.01$).

Table (5): Demonstrates that; there were statistically significant differences between different times of patients' assessment during hospitalization period (admission, 1st week, 2nd week and 3rd week) and wound healing ($p<0.01$).

Table (6): Shows that; there was a negative relationship between burn wound severity and some clinical parameters (Hg, Hct, fluid, calories and protein) in the second and third week.

Discussion

Nutrition has an important role in burn wound healing at all stages **(Quain & Khardori, 2015)** Regarding demographic data the findings of this study illustrated that two third of studied sample were males and the average age of them was thirty six, the majority of them were married, read and write, and farmer. This result confirmed by **Ahmed et al. (2019)** who carried out a systemic meta-analysis review on burned patients who revealed that two-third of studied sample were males and the average age of patients was thirty three. Also, **Keshavarzi et al. (2019)** carried out retrospective cross-sectional study among burned patients which revealed that the highest percentages of them were males and the average age of patients was thirty four.

Regarding clinical data the current study revealed that more than two- third of the studied patients had mixed second degree burn (superficial and deep), the most prevalent type of thermal burn was dry. Similar finding were found by **Tian et al. (2018);** who studied the characteristics of one thousand one hundred twenty two patients in China between 2011 and 2015.

Regarding, anthropometric measurements (BMI, MAMC, MAC, TSF) the current study revealed that there were statistical significant differences between different times of patients assessment during hospitalization period (admission, first, second and third week) and their anthropometric measurements. The obvious changes were observed in these parameters during the third week of assessment. This could be explained by, the subnormal measurement of these parameters it might be due to a lack of protein intake that did not compensate for protein loss, or it could be due to a hypermetabolic state and demand of burn injury.

Similarly, a descriptive correlational analysis was carried out by **Ahmed et al. (2019)** who found a significant reduction in the same parameter (anthropometric measurments) between the second and third week. Additionally, **Clark et al. (2017)** studied the current status of nutrition following burns and concluded that the hypermetabolic effects of burn damage cause nutrients to shift around due to inflammatory responses and edema formation.

Also, **Sinwar (2016)** added that, despite repletion with apparently adequate amounts of dietary protein and calories. Protein catabolism exceed anabolism, and weight loss following burn injury is inevitable. Similarly, **Romero et al. (2018)** supposed that the weight of burn patient increases in association with resuscitation fluid and subsequently decline throughout the hospitalization due to loss of muscle mass.

Regarding biochemical measurements, the current study found a statistically significant decrease in hemoglobin (Hb) level in the second and third week. From the researcher's point of view this may be due to anemia which can be due to blood loss from the burned region, frequent dressing changes, and serial blood extraction by venipuncture, as well as poor diet. In a similar vein, **Hammad et al. (2019)** found a marked reduction in hemoglobin level among studied patients.

Regarding WBCs our study showed a significant raising (leukocytosis) since admission till the end of the first week and returned to normal level in third week. In this regard **Moklin et al. (2015)** explained that the inflammatory systemic signs (changes in body temperature, tachycardia and leukocytosis) are used for diagnosis of sepsis, but sometimes this may be misleading, because burn patients often manifest a systemic inflammatory response syndrome without infection.

Regarding fluid therapy, the current study showed a statistical significant reduction on admission and first week. In the researcher's point of view this may be due to no monitoring there for intake and output where they didn't use intake and output chart. This finding supported by **Rowan et al. (2015)** who

stressed on the importance of fluid resuscitation and its effect on burn wound healing.

Regarding dietary management the highest percentage of patients had low calories and protein intake on admission and first week and increased gradually in second and third week. This may be was due to loss of appetite, nausea, vomiting or other physiological disorders. This supported by **Bishop et al. (2018)** who reported that the role of nutrition in successful wound healing. However, calories improved over measurements in second week and third week which could be due to increase appetite.

Regarding wound healing, the present study revealed that, statistical significant differences were found between different times of patients' assessment during hospitalization period (admission, first, second and third week) and wound healing. It was observed that the highest number of studied patients had minimal and mild severity of burn wound on admission.

The condition of the burn wound deteriorated in the third week where, some patients still had mild severity and others converted from minimal and mild to moderate and extreme severity. In the researcher point of view these findings might be linked to the size of the (TBSA), inadequate nutrition as protein which might predispose patients to malnutrition complications such as infection, or using improper aseptic technique in wound dressing procedures.

This was supported by **Bishop et al. (2018)** who found a significant link between poor nutrition and delay wound healing, with higher risk of complications such as infection or fails to heal in timely manner. Finally, the current study revealed that, there was negative relationship between burn wound severity and nutrition, fluid, calories, protein and Hb in second and third week, which means a deterioration in the burn wound condition with reduction of these parameters from minimal or mild to moderate and extreme severity. In a research done by **Mahakalkar et al. (2014)** to evaluate the malnutrition incidence and its impact on patient outcomes and found that altered nutrition resulted in impairment of wound healing.

Conclusions

A deterioration in burn wound condition from minimal to moderate and extreme severity was observed among studied patients with reduction of nutritional parameters (good nutrition, hemoglobin, fluid, calories and protein intake).

Recommendation

- Replication of study on larger sample from different geographical areas in Egypt.
- Nutritional elements must be provided for burned patients during all phases of burn wound healing process.

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