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Effect of Ozone Therapy Dressing Technique on the Healing Process of Recent 2nd Degree Burns

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Abstract: *Burn injuries are one of the major health problems throughout the world. The problem of infection in burn wound is considered the cause of death in burned patients.*

Aim of the study: *To determine the effectiveness of ozone therapy dressing technique on the healing process of recent 2nd degree burns.*

Material and Methods: *A convenience sample of 40 burned patients second burn wound injuries included in the study, they were divided randomly into two groups: study and control group, 20 patients in each group. The study group, its burn sites were dressed by ozone dressing technique by the researcher, the control group its burn sites were dressed by conventional dressing technique by the hospital staff according to the hospital routine, two tools were used to fulfil Tool I: burn wound assessment and Tool II burn wound dressing evaluation tool the objective of the study.*

Results: *significant difference was found between the two dressing techniques and wound pain, also a significant difference was found between study and control group in relation to healing process. Healing occurs in the study group after second, third week and before discharge.*

Conclusion: *Although the two dressing techniques (ozone dressing technique and conventional dressing techniques) were effective on healing process of 2nd degree burns, but ozone had faster healing effect than conventional dressing, it so represent the lowest and cost of dressing and days of hospital stay decreased.*

Recommendation: *ozonated water and ozonated olive oil recommend to be used on a daily based time to treat 2nd degree of burn wound. As well as training of nurses how to use ozone therapy and the technique for its using.*

Keywords: *ozone therapy, conventional dressing technique, recent 2nd degree burn, healing process.*

I. Introduction

Burn injuries has powerful effect on quality of life of victim suffering disability and financial loss.(1) Burn injuries are one of the major health problems throughout the world. The problems of infection in burn wound are usually considered the direct cause of death in many burned patients.(2)

In fact, approximately 500,000 persons seek medical treatment for burns every year in the United States.(3) In Alexandria Main University Hospital, 500 patients were admitted to the burn unit in the year 2012 requiring inpatient care.(4)

Burn wound is predisposed to infection due to damage of the protective skin barrier, facilitating entry of saprophytes, and pathogens. In a addition, it involves a large amount of dead tissues that remain in place for a long period of time. Burn injury to the skin causes massive release of humoral factors, including cytokines, prostaglandins, vocative prostanoids, and leukotreines. Accumulation of these factors at the site of injury leads to micro-organism multiplication and colonizing wounds to high densities.(5)

The pathogens that infect the wound are primarily gram-positive bacteria such as Methicillin-Resistant Staphylococcus Aureus (MRSA) and gram-negative bacteria such as Pseudomonas, and Klebsiella species. These latter pathogens are notable for their increasing resistance to a broad array of different antimicrobial agents. In addition, burn wounds are commonly infected with fungal pathogens leading to delayed healing, conversion of wound from partial to full –thickness burn, increased nutritional demands, increased scar and contracture formation.(6)

Clearly, healing of burn wound is described by the type of tissue forming epithelial, collagen or by the cell involved in the healing process (e.g. fibroblast, leukocyte).(7) Healing process are classified into three overlapping phases: inflammatory phase, proliferative phase and maturation phase. It can be influenced by local and systemic factors. Local factors include local blood supply, wound oxygen tension, temperature, infection and the effects of dressing or topical applications. Systemic factors include age and the presence of disease, particularly vascular disease, systemic infections or immunological incompetence. (8,9)

The healing process occurs either complete or partial. Russell (2000) described complete healing as

granulation tissue covered by migration and proliferation of epithelial cells within the wound space and formation of scar tissue. Partial healing is described as formation of granulation tissue within the wound space or decrease of wound size without formation of scar tissue. (10)

The nurse oversees the total care of the patient, coordinating activities with other disciplines such as occupational and physical therapy, social services, nutritional services and pharmacy. (11)

So, optimal care of the burned patient requires a distinctive multidisciplinary approach. Positive patient outcomes are dependent on the composition of the burn care team and close collaboration among the health members. At the centre of this team is the specialized burn nurse, the coordinator of all patient care activities. The nurse, who cares for burned patients, should possess a broad and update knowledge and skills to provide patient with adequate nursing care according to his needs. So, the nurse should assess the patients, condition, plan, implement and continuously evaluate of the nursing care provided. The nurse should have skills related to critical care techniques psychosocial and rehabilitation skills. Besides the previous skill she should has experience and specialists in wound management for burned patients.(12)

At the same time, the nurse should be specialist in wound care. As a burn wound heals, either spontaneously or through excision and grafting, the nurse is responsible for wound care and for noting subtle changes that require immediate attention, such as infection or pain management. So the nurse has continuously expanding role. (13)

The nurse has an important roles ,she is considered the corner stone for promotion of burned wound healing through assessing the patient conditions, planning patients care, and providing efficient care for respiratory and circulatory systems maintaining mobility, restoring the patients emotional and physical capacity, nutritional balance status, wound care and prevention of infection. (14,15) To promote healing of burn wound, the nurse has two main areas of responsibilities toward the patients to enhance wound healing primarily through the assessment of burn wound site , size, depth, edge surrounding area necrotic tissue and exudates. Secondary through caring for the wound. The dressing of burn wound, has many techniques this puts a burden on the nurse to decide which technique is best to use for burned patients.(16)

Regardless, dressing techniques that used, the nurse require a positive enthusiastic approach. The nursing profession always has been dependent on evidence base of research for the development of innovative and effective methods to treat, manage and enhance wound regeneration. (17)

There are many types of dressing techniques used for burned wound dressing as wet to dry and dry dressing. In Alexandria University Hospital the dry dressing technique with betadine 10% (povidone –iodine solution 10 %) is used for cleansing of burned wound for prevention of infection. Povidone –iodine is microbicidal bactericidal gram-negative and gram-positive bacteria, it kills fungi , viruses ,protozoa and growth yeast. The dry dressing technique is helpful in removing necrotic tissue and developing granulation tissues to grow. Many studies revealed that bad nursing intervention during dressing technique may cause burned wound to be infected that lead to many complications. (18)

Recently used Ozonated olive oil which has a fungicidal and bactericidal effect. Ozonated oil had been used locally for disinfecting lesions and promoting their healing. In European countries the ozonated olive oil has been applied on infected wound for promoting their healing.. Zidan (2006) confirmed the efficacy of ozonated olive oil dressing as a sole treatment of wound infection versus a systemic antibiotic and classical dressing. (20)

The development of new methods as well as the improvement of the current management of burned patients is of great importance in order to decrease the mortality. Ozone therapy is one of these methods and proved to be efficient in various diseases. Ozone treatment was used on gangrene, ulcers, diabetic ulcers and peripheral vascular disease. Moreover Ozone therapy has tremendously beneficial in treating burns, it is spectacular. It is so simple and inexpensive. (21)

Ozone therapy is effective in the management of burned patients, its mechanisms are bactericidic, antihypoxic, analgesic, antiflammatory, immunomodulating, detoxicating. For a direct fungicidal, bactericidal and virucidal effect, must use 80 to 100 ug/ml to achieve the breaking, of the virus capsule. Using a concentration of ozone therapy from 28 to 42 ug/ml will have systemic virucidal effect through an indirect mechanism of increasing immunity. (22)

Fortunately, ozone therapy is very effective for super-infected and badly healing wounds. It has wound cleansing effect, stops bleeding, and accelerates wound healing. Usually the ozone concentrations ranging from 40 to 100 ug per ml. For treatment of badly infected wounds or necrotic tissues to break up the scarring or relief of the inflammatory tissue start with at least 80 ug/ml, so that can get through the cell wall and into cellular metabolism. But if it is used topically, use of low concentrations to prevent destroying all the cells, good and bad, this destroying occurs by oxidizing and breaking down the essential fatty acid membrane that is around every cell. Where too high concentrations of ozone are damaging to the tissues.(23)

For external applications with bags (bag therapy), use about 32-40 ug/ml. If it is done properly it will never be harmful. Healing routinely occurs by placing a silicone bag above and below the wound or burn area.

So secure it with a rubber band, and then ozonate the area. It is simple and inexpensive.(24)

In addition to, Ozone can affect the circulation through reducing and eliminating clumping of red blood cells and restores its flexibility along with oxygen carrying ability where a clumping of red blood cells hinders blood flow through the small capillaries and decreases oxygen absorption due to reduced surface area in circulatory diseases. Oxygenation of the tissues is increased as a result of increasing arterial blood and decreasing viscosity of the blood. Ozone also oxidizes the plaques in arteries, allowing the removal of the break down products, unclotting the blood vessels. (25)

When ozone dissolves in the plasma, it is decompose in about one second and interacts with lipids, proteins, and carbohydrates, and generates a cascade of unstable and highly reactive oxygen intermediates among hydrogen peroxides and lipid oxidation products that allows its passive diffusions through the cell membrane from plasma. So, hydrogen peroxides become the ozone messenger able to activate specific kinas by phosphor elating protein blocking. Nuclear factor Kappa B activity allows the migration of the transcription heterodimer into the nucleus and cytoplasmic components leading to better oxygenation of the tissue. The effects of these oxygenation products extended up to 24 hours, and this explain the biological effects of ozone and its therapeutic actions. (26) Ozonated olive oil had a fungicidal and bactericidal effect; ozonated oil had been used locally for disinfecting lesions and promoting their healing, it can be used on all irritations and infections on the skin. Local ozone treatments are used for ulcerative wound, fistulas, decubitus ulcers and osteomyelitis. It speeds up healing while disinfecting the area of skin.(27)

Furthermore, the debridement action of ozone was explained by Tyagi (2005) as a chemical and enzymatic process. Ozone reacts with several biological compounds of the cells especially the lipid in a process of lipid per oxidation where poly unsaturated fatty acid (PUFAs) produces ozonide, aldehydes and hydrogen peroxide leading to changing in fluidity, alteration in the ion transport mechanism, distortion of signal transduction and increased permeability that can causes break down of the cell components with cell lysis. Rapid debridement of the wound from the scar is the end result lead to early formation of healthy granulation tissues ratio.(28)

El Shanaway ,et al study (2013) highlighted the efficacy of ozonated olive oil dressing technique on the healing superficial and deep diabetic foot ulcer this study found that ozone was pan bactericidal, pan veridical, antifungal and anti protozoal therapeutic. Moreover ozone improves oxygen supply in tissues so leading to rapid healing process.(29)

Many studies were done about dressing techniques and types of dressing used (14,15,19-20,25,27,28). Therefore, this study will be done to determine the effectiveness of ozone therapy dressing technique on the healing process of recent 2nd degree burns.

The results of this study indicate: improve cost effectiveness, decrease patient's problems and complications; decrease bed occupancy and increase turn over.

II. Aim of the study

The aim of this study is:

To determine the effectiveness of ozone therapy dressing technique on the healing process of recent 2nd degree burns.

Hypothesis

Burn wounds dressed using ozone therapy exhibit faster healing than those dressed using conventional dressing technique.

Operational definitions

For this particular research:

- **Ozone therapy dressing technique:** Is defined as advanced management for surgical wound, through ozone (generated by an ozone generator, EXT 120, Longevity, Canada).
- **Conventional dressing technique:** Is the application of hospital solution povidone-iodine (Betadine 10%) on the burn wound once daily.
- **Recent 2nd degree burn**: Burn wound with partial or mixed partial and full thickness burn with less than 10% full thickness injury or the percentage of burn will be range from 10-25% of total body surface area.-
- **Complete healing** formation: Mean presence of healthy granulation tissue covered by migration and proliferation of epithelial cells within the wound space and formation of scar tissue.
- **Partial healing formation:** Mean presence of healthy granulation tissue within the wound space or decrease of wound size without formation of scar tissue.
- **Incomplete healing**: Mean no improvement in wound characteristics or unhealthy granulation tissue.

III. Materials And Method

Materials

Research design: quasi experimental design was utilized**.**

Setting

This study was conducted in the burn unit at Alexandria Main University hospital.

Subjects

A convenience sample of 40 adult burned patients included in the study, they were divided randomly into two groups: study and control group 20 patients in each group:

Inclusion criteria for the burned patients were as the following :[1, 2]

- Recent burn in the first 12 hour post burn to limit the risk of infection
- Age: adult 21-60 year.
- Able to communicate
- The patient has 2nd degree burn wound total surface area of burn is less than 25% or mixed partial and full thickness burn with less than 10% full thickness injury.[14]
- Free from associated diseases as diabetes mellitus, renal failure and heart failure to control over such variables which affect wound healing.[9]

Study group (1): The burn sites of the study group were dressed by ozone dressing technique by the researcher.

Control group (11): The burn site of the control group was dressed by conventional dressing technique.

Tools

In order to fulfil the objective of the study, two tools were used for data collection:

Tool I: Burn wound assessment tool.

This tool was developed by the researcher after reviewing the related literature. [1, 2, 12-16, 24, 26]This tool was used to assess burned area. It consisted of 3 parts.

Part I

- Patient's Bio-socio-demographic and clinical data which include: age, sex, occupation, marital status and education level ,
- Patient's medical history and clinical data they included: date and time of admission, vital signs , medical diagnosis ,lab investigations , body mass index(BMI), prescribed treatment and date, time of discharge

Part II:

Burn wound parameters assessment check list.[30,31]

This part was included the following items:

a. Sites of burns
b. Etiology
c. Total body surface area of burned wound, which were measured by using Lund and Browder chart.[1]
d. Depth of burns was assessed clinically as second degree burn wound characterized by (wet, painful, red colour blanching on pressure) .

e. Burn wound characteristic (size – colour – discharge – depth – odor – presence of granulation tissue – pain and local signs of infection)

Part III:

Pain assessment severity by using numerical rating scale :[3, 4, 32]

Pain was assessed during dressing technique by using numerical scale once daily. This scale is useful tool to measure changes in pain and response to pain intervention by the researcher. This scale is start at the left side with "0" (No pain) and 10 indicate worst pain. To score the results in the horizontal 10 cm line from "0" to "10" according to the level of pain. Site of pain, character, duration, pain intensity and sedation to relieve pain.

Tool II: Burn wound dressing evaluation tool:

- This tool was developed by the researcher after reviewing the related literature.**[9,13,29,31]**It used to evaluate effect of dressing techniques, It was included five parts:

Part I

- Wound healing observation check list: this will contain the following items:

- Complete healing formation, partial healing or incomplete healing.

Part II

- Abnormal Findings of wound healing:- the wound was assessed in relation to the presence of:

a. Necrotic tissues.
b. Local signs of infection at wound margin, change of colour of wound, exudates or odor
c. Moist granulation tissue.
d. Increase surface areas of wound.
e. Unchanged surface areas of wound.
f. Absence of healing epithelial edges.

Part. III

- **Photographic pictures**

Photographic pictures were taken to compare wound healing process before starting dressing and before discharge.

Part. IV

- Laboratory studies(white blood cells and albumin level)
- Bacteriological wound culture to identify types of micro-organisms and to assess sensitivity test to antibiotic and infection rate areas in the unit of burn by the researcher before dressing and before patients discharge.

Part. V

- Cost of therapy

Method

1. Permission to carry out the study was taken from the responsible authorities after explaining the aim of the study to facilitate the researcher implementation.
2. The tools of the study were developed after reviewing the recent relevant literature.
3. The developed tools were subjected to 5 experts in the field of medical surgical nursing and plastic surgery tested for content validity.
4. Reliability of the tools was tested using test retest method.
5. Pilot studies were conducted on 5 patients to test feasibility of the tool and modifications were done.
6. Patients who were met the selection criteria were assigned alternatively to either the study group(1) who were subjected to daily dressing technique by ozone dressing technique ,and control group (11) who were subjected to conventional dressing technique (betadine, saline, dermazine).
7. Assessments of the patient's condition were done for each group using the developed tool I immediately on admission.
8. Study group were dressed by ozone therapy dressing technique once daily till healing occurs or discharge of patients (2week or until the end of 4^{th} week

The following dressing techniques were carried by the researcher: [15,16]

- Clean the wound from exudates tissue with sterile gauze.
- Debridement of the wound will be done with sterile scissor and forceps
- Clean the wound with saline soluation0.9 %.
- Dry the wound.
- Ozone (generated by an ozone generator, EXT 120, Longevity, Canada).
- From the time of admission, ozonized distilled water compresses were applied once daily on the burn wound then dressed by ozonized olive oil.
- In addition to, the burn wound was placed in a plastic bag, filled with ozone in oxygen with a concentration ranging from 15 to 60 µgm / ml for 20 minutes. This was applied daily, starting from the seventh day at the time of growth of granulation tissues.[27,28]
- Apply 1mm layer of Ozonated ointment directly onthe wound with using light bandage dressing with minimum pressure.

Wound culture done according to the following steps:[7,9,12]

A- Wash hands with soap and water and dry well then wear the gloves before culture procedures to prevent cross infection.
B- Expose the wound area
C- Using the cotton –tipped applicators swab and collection as much exudates as possible from the centre of the lesion.

D- Place the swab immediately in appropriate tube, transport culture tube and send to laboratory, labelled clearly with name of patient, date, room number, bed number specifying anatomic part from where the specimen was obtained
E- Record any abnormality if occurred.
9. Healing process of the wound was evaluated every week using burn wound dressing evaluation sheet using tool I I.
 Results of the local swab cultures interpret that for both groups.
10. Photographic pictures were taken on first week and before discharge to evaluate the healing process for both groups and to compare between the two groups.
11. Measured level of pain during dressing in both groups by using numerical rating scales for pain at first week and at discharge and compare between the two groups.
12. Body mass index was calculated by measuring:
- Measure height in meter for the patient's in both studied groups.
- Measure body weight in kg for the patients in both studied groups

Calculated body mass index through using the equation: $\frac{\text{Body weight in kg}}{\text{Height in meter}^2}$.

This calculation was done to determine the grade of obesity. [15,19,33]
Grade (0) BMI 20 -24.9 K gm/m2= desirable weight
Grade (1) BMI 25-29.9 K gm/ m2 =over weight
Grade (2) BMI 30-39.9 K gm/m2=obese
Grade (3) BMI 40 K gm/m2 or over = morbid obesity
Less than 18.5-24 Kg is considered under weight and excluded from the study, since this indicate deficit the nutritional status so, this may cause delay healing process.[1, 2]
13-Moreover the researcher assesses:
- Skin condition for (moist or dry), presence of any swelling

Measured the depth of the burn wound:

– The researcher observed and measured the depth, or thickness if the wound was superficial(epidermis) or partial thickness or skin loss that involve epidermis and /or dermis by using sterile cotton swab applicator insert into the deepest point of the wound and mark it at the skin surface level then the swab applicator is measured by ruler.[11,12]

Assess burn wound

The presence of granulation tissue or necrotic tissue or exposure of tendon was recorded.[34]

Assessment of abnormal findings of wound healing:

1- Assess if any clinical signs of wound infection: (redness, hotness, painful sensation unhealthy cells, tenderness, swelling, maceration, cellulites, edema, and eczema).
- Burn wound exudates (type, amount and odor) if present.

Types of exudates

-Bloody: thin bright red
- Serosanguineous: thin watery

Burn wound color

- Pale red to pink
- Serous: thin, watery, clear
- Purulent: thin or thick opaque to yellow
- Foul purulent: thick, opaque yellow to green

Amount of exudates

- Scanty
- Small
- Moderate
- Large

Odor from wound

- Absent or present
- Observe structure of the tissues for the following:

-Moist granulation tissue (dark red color with moisture evenly distributed in the wound.
-Necrotic tissues (black unhealthy tissues).
-Increase surface areas of wounds (increase wound width).
-Record any abnormality if occurred.
14-Calculate the frequency of performance of dressing in each dressing technique, time consumed by the nurse and cost of dressing. The time of daily dressing technique was ranged from33-50 minutes in the control group with the dressing were performed once daily until healing occur. The cost of daily dressing technique for the control group was 40 L.E. Which consists of regular bandage, sterile gloves, disposable gloves, sterile cotton sponge, gauze dressing scalpel and anti-septic solutions .While, the time consumed in ozone ointment dressing technique was ranged from30 to 60minutes (plus session of ozone) but the cost of ozone ointment was lower than conventional dressing. Count the average cost of each technique and hospital day of staying from the day of admission to the day of discharge.
15-Collection of data was done in7 months from the beginning of January 2014 to end of July 2014.

16- Ethical consideration which were followed by the researcher
– Approval consent was taken from the chief director of burn unit and approval consent from the head nurse in the unit.
– Confidentiality, anonymity and privacy was asserted
– The patient's was informed that their participation in the study is voluntary and can withdraw at any time
– Written patient consent.

Statistical Analysis
After the data were collected, they were coded and transferred into specially designed formats analyzed using the suitable SPSS/PC* (Statistical package for social science for personal computers).
1-Qualitative data were described using mean and standard deviation.
2-**Quantitative data were described using number and percentage**
3- "t" test: were used to determine difference between two groups
4- Chi-square (X^2): it used to test associated between two quantitative variables
For comparison between distributions of patients according to different items of study and use this formula for calculation:
5- Fisher exact test (FE) or montacarlo (MC): it was used to test (in case of chi-square not valid) and compare quantitative data.
6- Illustrated the results in statistical figures

IV. Results

The aim of the current study is to determine the effect of ozone therapy dressing technique on the healing process of recent 2nd degree burns. The study data were collected and analyzed using the mentioned methods.
The results of the current study are divided into five parts:
Part I: - Illustrated the biosocio-demographic and clinical data of the stud**y** and control group (Table I Figure11-a,11-b)
-Distribution of both studied groups regarding to vital signs, Complete Blood Count, Body Mass Index (BMI) during hospital period Tables (II, III and IV).
Part II: includes Distribution of both studied groups regarding to wound assessment on admission**,** wound pain and comparison of both groups relating to abnormal wound healing during hospital period Tables (V, VI, VII and Figure 12) .
Part III: includes comparison between study and control group regarding to: swab culture, type of microorganisms and wound healing during hospital period Tables (VIII, IX, Xa, Xb Figure 13, 14 and15).
Part 1V: Relation between burn wound healing groups and biosocio- demographic characteristics Table (XI)
- Relation between wound healing and burn wound assessment of the study group at the end of hospital period. Table (XII).
Part V: Comparison between two studied groups according to:
-Hospital stay period
- Cost of dressing
- Time consumed during dressing. Table (XIII, figure16

Part I: Distribution of the study group (ozone dressing technique) and control group (conventional dressing technique) regarding to Biosociodemographic and clinical data. (Tables I, II, III and IV) and (Figure 11a, b).

Table (I). Distribution of the study group (ozone dressing technique) and control group (conventional dressing technique) regarding to Biosociodemographic and clinical data.
This table shows the distribution of the study group (ozone dressing technique) and control group (conventional dressing technique) regarding to Biosociodemographic and clinical data. As regards to age; it was found that the majority of patient's age in both studied groups were ranged from 40-50 years with a percentage of 45.0% and 30.0%years for study and control groups respectively.
According to gender, the majority of the patients in the both groups (study and control) were males (75.0%, 60.0 % respectively). As for occupation, about 45.0% of patients in both groups (study and control) were manual working while, 40.0% had not working. In relation to marital status, (40.0%) of the patients in both studied groups (study and control) were married. Also, the educational level 40.0 % patients' of both groups were illiterate. In addition to medical diagnosis the results showed that, more than half of patients in both groups (study and control) were have scaled burn (65.0%).
There were no statistical significance differences were found between both studied groups in relation to **Biosociodemographic and clinical data**.

Table (I): Biosociodemographic and clinical data of the study and control group

Biosociodemographic and clinical data	**Study (n = 20)**		**Control (n = 20)**		χ^2	**p**
	No.	**%**	**No.**	**%**		
Age						
21>30	2	10.0	6	30.0		
30>40	2	10.0	5	25.0		
40>50	9	45.0	6	30.0	5.886	0.218
50>60	6	30.0	3	15.0		
60-	1	5.0	0	0.0		
Gender						
Male	15	75.0	12	60.0	1.026	0.311
Female	5	25.0	8	40.0		
Occupation						
Manual worker	9	45.0	9	45.0		
Employee	3	15.0	3	15.0	0.129	^{MC}p =1.000
Not working	8	40.0	8	40.0		
Marital status						
Single	7	35.0	7	35.0		
Married	8	40.0	8	40.0	0.0	1.00
Divorced	5	25.0	5	25.0		
Widow	0	0.0	0	0.0		
Educational level						
Illiterate	8	40.0	8	40.0		
Read & write	7	35.0	7	35.0	0.0	1.000
Primary	5	25.0	5	25.0		
Secondary	0	0.0	0	0.0		
Medical diagnosis						
scaled burn	13	65.0	13	65.0		
Flam	5	25.0	5	25.0	0.180	^{MC}p = 1.000
Electric	2	10.0	2	10.0		

χ^2: value for Chi square
MC: Monte Carlo test
*: Statistically significant at $p \leq 0.05$

Table (II): Distribution of both studied groups regarding to vital signs during hospital period.
This table revealed distribution of both studied groups regarding to vital signs during hospital period. It was found that, the temperature of more than half of study and control group patients were having normal temperature (55.0 %,) after the first week .However, the temperature of both study and control groups were normal (60%) after second week, (100.0**%**, 76.5**%, respectively**) after third week, and before discharge
As regard to their, pulse, blood pressure and respiration .It was found that most patients in both study and control groups were having normal , **puls**e(100.0.0**%** 76.0**%** respectively)**,** ,**Blood pressure** (86.7% ,88,2% respectively) and **Respiration(**100.0**%.76.5%** respectively)at the end of third week**.**
No statistical significant difference between both studied groups regarding to Patients vital signs; (temperature, pulse, respiratory rate and hospital period blood pressure) were found at $p \leq 0.05$.

Table (II): Distribution of both studied groups regarding to vital signs during the hospital stay period

Vital signs during the follow up period	After First week		After Second week		After Third week		Before discharge	
	No.	%	No.	%	No.	%	No.	%
Temperature								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
Abnormal	9	45.0	8	40.0	0	0.0	0	0.0
Normal	11	55.0	12	60.0	15	100.0	10	100.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
Abnormal	9	45.0	8	40..0	4	23.5	4	26.7
Normal	11	55.0	12	60.0	13	76.5	11	73.3
$\square^2$	0.0		0.0		4.034		1.985	
^{FE}p	1.000		1.000		0.104		0.274	
Pulse								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
Abnormal	9	45.0	8	40.0	0	0.0	0	0.0
Normal	11	55.0	12	60.0	15	100.0	10	100.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
Abnormal	9	45.0	8	40..0	4	23.5	4	26.7
Normal	11	55.0	12	60.0	13	76.5	11	73.3
$\square^2$	0.0		0.0		4.034		1.985	
^{FE}p	1.000		1.000		0.104		0.274	
Blood pressure								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
Abnormal	9	45.0	8	40.0	2	13.3	0	00.0
Normal	11	55.0	12	60.0	13	86.7	10	100.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
Abnormal	9	45.0	8	40.0	2	11.8	4	26.7
Normal	11	55.0	12	60.0	15	88.2	11	73.3
$\square^2$	0.0		0.0		0.018		1.271	
^{FE}p	1.000		1.000		0.893		0.516	
Respiration								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
Abnormal	9	45.0	8	40.0	0	0.0	0	0.0
Normal	11	55.0	12	60.0	15	100.0	10	100.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
Abnormal	9	45.0	8	40..0	4	23.5	4	26.7
Normal	11	55.0	12	60.0	13	76.5	11	73.3
$\square^2$	0.0		0.0		4.034		1.985	
^{FE}p	1.000		1.000		0.104		0.274	

$\square^{\square}$: value for Chi square
FE: Fisher Exact test
#: The remaining numbers of patients in each type of technique were discharged

Table (III): Distribution of both studied groups regarding to Complete Blood Count during hospital stay period. This table Shows distribution of both studied groups regarding to Complete Blood Count during hospital stay period As regarding to, the level of White Blood Cells (WBC), Platelets in the majority of patients in both study and control groups were ranged from (100.0%-80.0%.- respectively) within normal range before discharge.
Also, the percentage of Hematocrite (HCT),Red blood cells(RBC) and Hemoglobin (HB) ,Albumin (ALB) of patients in both study and control groups were ranged from(80.0% and 86.7% respectively) within normal range before discharge

No Statistical significant differences between both studied groups in relation to all blood profile were found at $p \leq 0.05$.

Table (III): Distribution of both studied groups regarding to Complete Blood Count during hospital stay period

CBC during follow up period	After First week		After Second week		After Third week		Before discharge	
	No.	%	No.	%	No.	%	No.	%
WBC								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
Abnormal	18	90.0	17	85.0	4	26.7	0	0.0
Normal(3.8-9.810$^{3\backslash micro\ liters)}$	2	10.0	3	15.0	11	73.3	10	100.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
Abnormal	18	90.0	17	85.0	4	23.5	3	20.0
Normal	2	10.0	3	15.0	13	76.5	12	80.0
$\square^{\square}$	0.0		0.0		0.042		2.273	

^{FE}P	1.000		1.000		1.000		0.250	
PLT								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
Abnormal	18	90.0	17	85.0	2	13.3	0	0.0
Normal	2	10.0	3	15.0	13	86.7	10	100.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
Abnormal	17	85.0	17	85.0	2	11.8	3	20.0
Normal	3	15.0	3	15.0	15	88.2	12	80.0
□□	0.229		0.0		0.018		2.273	
^{FE}P	1.000		1.000		0.893		0.250	
HCT								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
Abnormal	4	20.0	4	20.0	3	20.0	2	20.0
Normal	16	80.0	16	80.0	12	80.0	8	80.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
Abnormal	4	20.0	4	20.0	3	17.6	2	13.3
Normal	16	80.0	16	80.0	14	82.4	13	86.7
□□	0.0		0.0		0.029		0.198	
^{FE}P	1.000		1.000		1.000		1.000	
RBC								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
Abnormal	15	75.0	13	65.0	3	20.0	2	20.0
Normal(3.5-5.2 $10^{6)}$	5	25.0	7	35.0	12	80.0	8	80.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
Abnormal	15	75.0	13	65.0	3	17.6	2	13.3
Normal	5	25.0	7	35.0	14	82.4	13	86.7
□□	0.0		0.0		0.029		0.198	
P	1.000		1.000		100.0		1.000	
HB								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
Abnormal	14	70.0	14	70.0	3	20.0	2	20.0
Normal m:13.8-17.2 g\dl- f:12.1-15.1 g\dl	6	30.0	6	30.0	12	80.0	8	80.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
Abnormal	13	65.0	14	70.0	3	17.6	2	13.3
Normal	7	35.0	6	30.0	14	82.4	13	86.7
□□	0.114		0.0		0.029		0.198	
P	0.736		1.000		100.0		1.000	
ALBumin level								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
Abnormal	15	75.0	13	65.0	3	20.0	2	20.0
Normal (3.6-5.0 g\dl)	5	25.0	7	35.0	12	80.0	8	80.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
Abnormal	15	75.0	13	65.0	3	17.6	2	13.3
Normal	5	25.0	7	35.0	14	82.4	13	86.7
□□	0.0		0.0		0.029		0.198	
^{FE}p	1.000		1.000		100.0		1.000	

□□: value for Chi square FE: Fisher Exact test *: Statistically significant at $p \leq 0.05$

#: The remaining numbers of patients in each type of technique were discharged.

Table (IV): Distribution of both studied groups regarding to B**ody Mass** I**ndex (BMI)**

This table reveals distribution of both studied groups regarding to B**ody Mass** I**ndex (BMI)**. It was found that BMI, 80.0**%** of patients in the study group were desirable weight as compared to 66.0**%** of patients in the control group before discharge .There was no statistical significant difference between both studied groups regarding to BMI at $p \leq 0.05$

Table (IV): Distribution of both studied groups regarding to Body Mass Index (BMI)

Body mass index	**After First week**		**After Second week**		**After Third week**		**Before discharge**	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
Grade (0) 20-24.9 (desirable)	12	60.0	13	65,0	10	66.7	8	80.0
Grade (1) 25-29.9 (over weight)	8	40.0	7	35.5	5	33.3	2	20.0
Grade (2) 30-39.9 (obese)	0	0.0	0	0.0	0	0.0	0	0.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
Grade (0) 20-24.9	11	55.0	13	65.0	10	58.8	10	66.7
Grade (1) 25-29.9	9	45.0	7	35.0	7	41.2	5	33.3
Grade (2) 30-39.9	0	0.0	0	0.0	0.0	0.0	0	0.0
□□	0.102		0.0		0.209		0.529	
P	0.749		1.000		0.647		0.467	

χ^2: value for Chi square
#: The remaining numbers of patients in each type of technique were discharged

Part II: Distribution of both studied groups regarding to burn wound assessment on admission. (Tables V, VI and VII) .

Table (V) Distribution of both studied groups regarding to wound assessment **on admission.**

This table illustrated distribution of both studied groups regarding to wound assessment **on admission.**

As for the site of burn wound. It was found that, 55.0**%** of the patients were had wound in hands in the study and control group. **Concerning, the cause** of burn injuries. It was found that, the most common cause of burn were scaled 65.0**%** in both group the study and control.

Moreover, regarding the degree of burn. It was found that, the degree of burn wound of patients in the study and control group were the second degree it was classified into 2nd superficial and 2nd deep. For the 2nd superficial degree were 75.0**%** in the study group as compared of patients in control group were 80.0**%** .However the 2nd deep degree were 25.0**%** in the study group as compared of patients in control group were 20.0. **% . There** were no statistical significant differences between both studied groups regarding to degree of burn at $p \leq 0.05$.

In addition to the colour of the wound. It was found that, red colour were presented for the majority of patients in the study and control group (95.0 **%,** 75.0 **% respectively)**.

Regarding to size of burn wound. The results revealed that, in the study and control group, the size of burn ranged from14.0 – 25. **0%**. No statistical significant difference at $p \leq 0.05$. **As for presence of granulation** tissues. **Granulation** tissues were not present in both the study or control group.

Moreover, no signs of infection were present in the study and control patients group at admission. So, there were no statistical significant differences between both studied groups regarding to burn wound assessment **on admission** ($p \leq 0.05$).

Table (V): Distribution of both studied groups regarding to burn wound assessment on admission

wound assessment	Study (n = 20)		Control (n = 20)		Test of sig.	P
	No.	%	No.	%		
Site of burn						
Hand	11	55.0	11	55.0	0.0	1.000
Leg	9	45.0	9	45.0		
Cause of burn						
Scaled	13	65.0	13	65.0		
Thermal	5	25.0	5	25.0	χ^2 = 0.0	1.000
Chemical	0	00.0	0	00.0		
Electrical	2	10.0	2	10.0		
Degree of burn						
2nd superficial	15	75.0	16	80.0	χ^2 = 0.143	FEp=1.000
2nd deep	5	25.0	4	20.0		
Size of burn wound						
Min. – Max.	14.0 – 25.0		14.0 – 25.0		t= 0.253	0.802
Mean ± SD.	18.35 ± 3.46		18.60 ± 2.74			
Median	17.0		18.0			
Colour						
Red	19	95.0	15	75.0	χ^2 = 3.137	0.182
Other	1	5.0	5	25.0		
Odour						
Yes	0	0.0	0	0.0		-
No	20	100.0	20	100.0		
Presence of granulation						
Yes	0	0.0	0	0.0	-	-
No	20	100.0	20	100.0		
Local infection						
Yes	0	0.0	0	0.0	-	-
No	20	100.0	20	100.0		

χ^2: Chi square test
FE: Fisher Exact test
t: Student t-test
*: Statistically significant at $p \leq 0.05$

Table (VI): Comparison between the two studied groups relating to abnormal healing during hospital stay period.

This table shows the Comparison between the two studied groups relating to abnormal healing during hospital stay period.

As for as, surrounding area **(margin):** In study group it was found that, 100.0% of patients had not any necrotic tissue surrounding area as compared to control patients group 33.3% at the end of follow up (before discharge). There was a statistical significant difference between both studied groups regarding surrounding area necrotic tissue at ($p < 0.001^*$)

Regarding signs of infection in the study patients group no abnormality occurred as compared with control patients group were feverish 33.0% at the end of hospital period(before discharge) that indicates the ozone dressing has(panbacteriocidal action)

Moreover, patients in the study group had **not Violaceous discoloration**. However, the percentage of patients had **Violaceous discoloration** in control group were13.3% before discharge.

In the study group patients had normal **condition no signs or symptoms occurred before discharged.** However in control patients group had exudates '(yellow) 60.0% and 20.0% green before discharge. In addition to presence of discharge at the end of first and second weeks. Also, 20%from control patients group had hemorrhage, 33.3% of them had sloughing **a**nd **Absence of epithelial** tissues formation, moist granulation tissues at the same time and progression of partial thickness to full thickness injuries.

Table (VI): Comparison between the two studied groups relating to abnormal healing during hospital stay period.

Abnormal wound healing during hospital stay period	After First week		After Second week		After Third week		Before discharge	
	No.	%	No.	%	No.	%	No.	%
1-Wound margin(necrotic tissue)								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
No	20	100.0	20	100.0	15	100.0	10	100.0
Yes	0	0.0	0	0.0	0	0.0	0	0.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
No	0	0.0	1	5.0	0	0.0	5	33.3
Yes	20	100.0	19	95.0	17	100.0	10	66.7
□□	40.000*		36.190*		32.000*		11.111*	
P	<0.001*		<0.001*		<0.001*		0.001*	
2-Manifestation sign of infection								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
No	10	50.0	14	70.0	15	100.0	10	100.0
Redness	5	25.0	3	15.0	0	0.0	0	0.0
Hotness	5	25.0	3	15.0	0	0.0	0	0.0
Tenderness	0	0.0	0	0.0	0	0.0	0	0.0
Swelling	0	0.0	0	0.0	0	0.0	0	0.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
No	8	40.0	9	45.0	10	58.8	10	66.7
Redness	4	20.0	3	15.0	1	5.9	0	0.0
Hotness	6	30.0	6	30.0	5	29.4	5	33.3
Tenderness	1	5.0	1	5.0	1	5.9	0	0.0
Swelling	1	5.0	1	5.0	0	0.0	0	0.0
□□	2.379		3.977		7.602*		4.167*	
MCp	0.873		0.340		0.019*		0.041*	
3-Change of colour								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
No	20	100.0	20	100.0	15	100.0	10	100.0
Violaceous discoloration	0	0.0	0	0.0	0	0.0	0	0.0
Brown discoloration	0	0.0	0	0.0	0	0.0	0	0.0
Black discoloration of wound	0	0.0	0	0.0	0	0.0	0	0.0
Not progressing from pink to beefy red	0	0.0	0	0.0	0	0.0	0	0.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
No	20	100.0	16	80.0	9	52.9	7	46.7
Violaceous discoloration	0	0.0	3	15.0	2	11.8	2	13.3
Brown discoloration	0	0.0	1	5.0	0	0.0	0	0.0
Black discoloration of wound	0	0.0	0	0.0	0	0.0	0	0.0
Not progressing from pink to beefy red	0	0.0	0	0.0	6	35.3	6	40.0
□□	-		3.978		9.047*		7.328*	
MCp	-		0.104		0.006*		0.008*	

□□: Chi square test*: Statistically significant at $p \leq 0.05$

#: The remaining numbers of patients in each type of technique were discharged.

Table (VI): (cont) Comparison between the two studied groups relating to abnormal healing during hospital stay period

Abnormal wound healing during hospital stay period	After First week		After Second week		After Third week		Before discharge	
	No.	%	No.	%	No.	%	No.	%
4-Exudates								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
No	9	45.0	8	40.0	7	46.7	10	100.0
Yellow	0	0.0	2	10.0	8	53.3	0	0.0
Green	0	0.0	0	0.0	0	0.0	0	0.0
Brown	0	0.0	0	0.0	0	0.0	0	0.0
Bloody	11	55.0	10	50.0	0	0.0	0	0.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
No	5	25.0	10	50.0	2	11.8	3	20.0
Yellow	0	0.0	0	0.0	10	58.8	9	60.0
Green	0	0.0	0	0.0	3	17.6	3	20.0
Brown	0	0.0	0	0.0	0	0.0	0	0.0
Bloody	15	75.0	10	50.0	2	11.8	0	0.0
□□	1.758		1.879		7.011*		15.224*	
P	0.185		0.526		**MC**p 0.043*		**MC**p <0.001*	
5-Sloughing								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
No	20	100.0	20	100.0	15	100.0	10	100.0
Yes	0	0.0	0	0.0	0	0.0	0	0.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
No	20	100.0	18	90.0	13	76.5	10	66.7
Yes	0	0.0	2	10.0	4	23.5	5	33.3
□□	-		2.105		4.034		4.167	
P	-		0.487		0.104		0.061	
6--Hemorrhage								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
No	20	100.0	20	100.0	15	100.0	10	100.0
Yes	0	0.0	0	0.0	0	0.0	0	0.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
No	20	100.0	18	90.0	14	82.4	12	80.0
Yes	0	0.0	2	10.0	3	17.6	3	20.0
□□	-		2.105		2.921		2.273	
P	-		0.487		0.229		0.250	

□□: Chi square test*: Statistically significant at $p \leq 0.05$

#: The remaining numbers of patients in each type of technique were discharged.

Table (VI): (cont) Comparison between the two studied groups relating to abnormal healing during hospital stay period

Abnormal wound healing during hospital stay period	After First week		After Second week		After Third week		Before discharge	
	No.	%	No.	%	No.	%	No.	%
7-Formation of abnormal granulation tissues								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
No	20	100.0	20	100.0	15	100.0	10	100.0
Yes	0	0.0	0	0.0	0	0.0	0	0.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
No	20	100.0	20	100.0	10	58.8	10	66.7
Yes	0	0.0	0	0.0	7	41.2	5	33.3
□□	-		-		7.906*		4.167	
P	-		-		0.008*		0.061	
8- Formation of abnormal epithelial cells								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
No	20	100.0	20	100.0	15	100.0	10	100.0
Yes	0	0.0	0	0.0	0	0.0	0	0.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
No	20	100.0	20	100.0	15	88.2	10	66.7
Yes	0	0.0	0	0.0	2	11.8	5	33.3
□□	-		-		1.882		4.167	
P	-		-		0.486		0.061	

□□: Chi square test

*: Statistically significant at $p \leq 0.05$

#: The remaining numbers of patients in each type of technique were discharged.

Table (VII): Relationship of both studied groups regarding to wound pain during hospital stay period.
This table illustrates the relation of both studied groups regarding to **wound pain during hospital stay period**
Patients' managed by ozone dressing technique (study group) were experienced pain during dressing at the end of 1st,2nd, and 3rd week and before discharge (80%, 60.0 %, ,33.3% and20.0% respectively). On the other hand, patients' managed by **conventional dressing technique (**control group) were experienced pain (100%, 80%, 76.5% and 66.7% respectively).That revealed the effect of ozone dressing through experience of pain starting to decrease during hospital stay period.
The statistical significant difference was found between two dressing techniques and wound pain during dressing at p ≤ (0.014* , <0.041*)

Table (VII): Relationship of both studied groups regarding to wound pain during hospital stay period

Pain during two dressing technique	After First week		After Second week		After Third week		Before discharge	
	No.	%	No.	%	No.	%	No.	%
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
Yes	16	80.0	12	60.0	5	33.3	2	20.0
No	4	20.0	8	40.0	10	66.7	8	80.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
Yes	20	100.0	16	80.0	13	76.5	10	66.7
No	0	0.0	4	20.0	4	23.5	5	33.3
□□	2.500		1.905		6.026*		5.235*	
P	FEp =0.106		0.168		0.014*		0.041*	

□□: Chi square test
FE: Fisher Exact test#:
The remaining numbers of patients in each type of technique were discharged
*: Statistically significant at p ≤ 0.05

Part III: Comparison between study and control group regarding to: swab culture, type of microorganisms and wound healing during hospital period. (Tables VIII, IX, Xaand Xb) .
Table (VIII): Comparison between the two studied groups relating to swab culture at different periods of hospital stay
This table shows the Comparison between the two studied groups relating to swab culture at different periods of hospital stay
As regards patients in the study group 55.5% of them had sterile (negative) swab culture after the end of second weeks as compared to 50.0% only in control group.
Before discharge all patients in the study group100. 0% had negative swab .while, The patients in the control group81.8% from them had negative swab culture and 18,2 % of them had positive swab before discharge. But no statistical significant difference was found between the study group and control group in relation to swab culture, before discharge (p = 1.000) at level of significant at p≤0.05

Table (VIII): Comparison between the two studied groups relating to swab culture at different periods of hospital stay.

Swab culture at different periods of hospital stay	After First week		After Second week		After Third week		Before discharge	
	No.	%	No.	%	No.	%	No.	%
Study group**	**(n = 20)**		**(n = 20)**		**(n = 8)**		**(n = 2)**	
Negative	10	50.0	11	55.5	7	87.5	2	100.0
Positive	10	50.0	9	45.5	1	12.5	0	0.0
Control group**	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 11)**	
Negative	8	40.0	10	50.0	10	58.8	9	81.8
Positive	12	60.0	10	50.0	7	41.2	2	18.2
□□	0.404		0.100		2.056		0.430	
P	0.525		0.752		0.205		1.000	

□□: value for Chi square
FE: Fisher Exact test
*: Statistically significant at p ≤ 0.05
**Some of subject of the two studies not done for them culture due to complete healing occured

Table (IX): Relationship of both studied groups regarding to type of microorganisms in swab culture during hospital period.
This table illustrates the relationship of both studied groups regarding to type of microorganisms in swab culture during hospital period.

The table revealed that presence or absent of microorganisms and its type in both the study and control groups, the result of first culture post burn indicates that, the percentage of presence Staph aureus (40.0%,25.0%) pseudomonas (30% 25.0%) Streptococcus (30%, 16.7%) E-coli(0 ., 33%) respectively.

As for, The second culture post burn shows staphylococcus and pseudomonas (33.3%,**%30%).While, streptococcus(33.3%,10.0%) .Also, E** -coli (0 ., 30%) **respectively in both groups**

The third culture post burn shows that staphylococcus aureus decrease in both studied patients group respectively at the end of third week(0.0% ,42.9%) and before discharge(0.%,50%).,pseudomonas (0.0%,28.6%) **and E** -coli (0 ., 14.3%) **respectively in both groups that revealed** percentage of presence Staph aureu, pseudomonas and **E** -coli **. No** statistical significant difference was found between the study and control group regarding to types of microorganisms, after third week and before discharge at the Level of significant at $p \leq 0.05$.

Table (IX): Relationship of both studied groups regarding to percentage and type of microorganisms in swab culture during hospital period.

Type of Microorganisms	After First week		After Second week		After Third week		Before discharge	
	No.	%	No.	%	No.	%	No.	%
Study group								
Staph, aureus	4	40.0	3	33.3	0	0.0	0	0.0
Pseudomonas	3	30.0	3	33.3	0	0.0	0	0.0
Streptococcus	3	30.0	3	33.3	1	100.0	0	0.0
E,-coli	0	0.0	0	0.0	0	0.0	0	0.0
Total	**10**		**9**		**1**		**0**	
Control group								
Staph, aureus	3	25.0	3	30.0	3	42.9	1	50.0
Pseudomonas	3	25.0	3	30.0	2	28.6	0	0.0
Streptococcus	2	16.7	1	10.0	1	14.3	1	50.0
E,-coli	4	33.3	3	30.0	1	14.3	0	0.0
Total	**12**		**10**		**7**		**2**	
χ^2	4.080		3.641		3.492		-	
^{FE}p	0.262		0.353		0.624		-	

χ^2: Chi square test

FE: Fisher Exact test

*: Statistically significant at $p \leq 0.05$

#: The remaining numbers of patients in each type of technique were discharged.

Table (Xa): Distribution of both studied groups regarding to wound healing during hospital stay period.

This table shows the distribution of both studied groups regarding to wound healing during hospital stay period .The table revealed that, study group, 80.0% of patients had complete wound healing before discharge as compared to 26.7% only in control group while 20.0% of the study group had partial wound healing. As for control group it was found that, at the end of follow up period, 40.0% of patient had partial wound healing, and 33.3% of them complained of no healing. A statistical significant difference was found between the study group and control group in relation to healing process after second, third week and before discharge at Level of significant at $p \leq 0.05$.

Table (X a): Distribution of both studied groups regarding to wound healing during hospital stay period

Wound healing during hospital stay period	First week		Second week		Third week		At the end of fourth week or before discharge	
	No.	%	No.	%	No.	%	No.	%
Wound healing								
Study group	**(n = 20)**		**(n = 20)**		**(n = 15)**		**(n = 10)**	
Complete	0	0	0	0.0	7	46.7	8	80.0
Partial	0	0	10	50.0	6	40.0	2	20.0
No healing	20	100.0	10	50.0	2	13.3	0	0.0
Control group	**(n = 20)**		**(n = 20)**		**(n = 17)**		**(n = 15)**	
Complete	0	0	0	0.0	0	0.0	4	26.7
Partial	0	0	3	15.0	5	29.4	6	40.0
No healing	20	100.0	17	85.0	12	70.6	5	33.3
χ^2	-		5.584*		14.602*		7.150*	
^{MC}p	-		0.018*		0.001*		0.025*	

χ^2: value for Chi square

MC: Monte Carlo test

*: Statistically significant at $p \leq 0.05$

#: The remaining numbers of patients in each type of technique were discharged

Table (X b): Total distribution of all subjects in study and control group regarding to wound healing during hospital period

This table illustrated the distribution of all patients in study and control group regarding to wound healing during hospital period, the remaining number of patients in each type of technique during hospital period were in study group discharged at the beginning of 3rd week were 100% had partial healing and 80% of them discharged with complete wound healing at the fourth week. So the total numbers of patients in study group were 65% had complete wound healing and 35% had partial healing.

As regards to, patients in control group 20.0% had complete healing, 55% had partial healing and 25% had no healing at the end of fourth week So, the results indicate the high percentage of complete healing occurring in study group managed by ozone dressing technique (**faster wound healing**) than the patients' managed by conventional technique.

Table (X b): Total distribution of all patients in study and control group regarding to wound healing during hospital period

Wound healing during hospital stay period	Remaining number of patients in each type of technique discharge during hospital period						Total (n = 20)	
	Discharged At the beginning of 3rd week		Discharged At the end of 3th week		Discharged during or at the end of fourth week			
	No.	%	No.	%	No.	%	No.	%
Study group	(n = 5)		(n = 5)		(n = 10)			
Complete	0	0.0	5	100.0	8	80.0	13	65.0
Partial	5	100.0	0	0.0	2	20.0	7	35.0
No healing	0	0.0	0	0.0	0	0.0	0	0.0
Control group	(n = 3)		(n = 2)		(n = 15)			
Complete	0	0.0	0	0.0	4	26.7	4	20.0
Partial	3	100.0	2	100.0	6	40.0	11	55.0
No healing	0	0.0	0	0.0	5	33.3	5	25.0

Part IV:Relation between burn wound healing and biosocio- demographic characteristics of the study group (Table XI and XII)

Table (XI): Relations between burn wound healing and biosocial-demographic characteristic of study group at the end of hospital stay period.

This table illustrates the relations between burn wound healing and biosocial-demographic characteristic of study group at the end of hospital stay period. It was found that, there were relations between burn wound healing and some biosocial-demographic characteristics of study group. Complete healing occurred for patients between ages of 21- less than 50 years. As for males, complete healing occurred for 77.0%, while female complete healing occurred for 23.0%of patients. While, desirable body weight registered complete healing were 77.0%. No significant relations between sex, occupation, education level and BMI were found at the end of the follow up period at ($p \leq 0.05$). But significant relations were found between age and type of healing at $^{MC}p= 0.001^{*}$

Table (XI): Relations between burn wound healing and bio socio-demographic characteristics of the study group at the end of hospital stay period.

Characteristics	End of follow up period				□ □	P
	Study group					
	Partial		Complete healing			
	"n=7"		"n=13"			
	No.	%	No.	%		
Age						
21>30	0	0.0	2	15.4		
30>40	0	0.0	2	15.4		
40>50	0	0.0	9	69.2	18.708*	$^{MC}p= 0.001^{*}$
50>60	6	85.7	0	0.0		
60-	1	14.3	0	0.0		
Gender						
Male	5	71.4	10	77.0	0.073	$^{FE}p = 1.000$
Female	2	28.6	3	23.0		
Occupation						
Manual worker	3	42.85	6	46.2		
Employee	1	14.3	2	15.4	0.313	$^{MC}p = 1.000$
Not working	3	42.85	5	38.4		
Educational level						

Illiterate	2	28.6	6	46. 2		
Read & write	3	42.8	4	30.8	0.783	$^{MC}p = 0.849$
Primary	2	28.6	3	23.0		
Secondary	0	0.0	0	0.0		
BMI (4th)						
Deserible weight	2	28.6	10	77..0		
Over weight	5	71.4	3	23.0	4.432	$^{FE}p = 0.062$
Obese	0	0.0	0	0.0		

□□: value for Chi square
FE: Fisher Exact test
MC: Monte Carlo test
* Level of significant at $p \leq 0.05$
N.S. Not significant difference
#: The remaining numbers of patients in each type of technique were discharged.

Table (XII): Relations between burn wound healing and some burn wound assessment of the study group at the end of hospital stay period.
This table shows the relations between burn wound healing and some burn wound assessment to study group at the end of hospital stay period. It was found that, there were relations between wound healing and some burn wound assessment. The healing of wound was complete when its site were in hands 77% but the percentage of healing in legs were 23.0% at $^{FE}p = 0.017^{*}$
Also the complete healing occurred in 69.3% when the cause of burn was scaled $^{*\,MC}p = 0.133$.
There were significant relation was found between site, degree of burn wound and it's healing at the end of follow up period at ($p = 0.031^{*}$).
Furthermore, there were no significant relation was found between cause, size, and color of wound and it's healing at the end of follow up period at ($p \leq 0.05$).

Table (XII): Relations between wound healing and burn wound assessment of the study group at the end of hospital stay period.

Burn wound assessment	**End of follow up period study group**				□□	**P**
	Partial "n=7"		**Complete healing "n=13"**			
	No.	**%**	**No.**	**%**		
Site of burn						
Hand	1	14.3	10	77.0	7.213^{*}	$^{FE}p = 0.017^{*}$
Leg	6	85.7	3	23.0		
Cause of burn						
Scaled	4	57.2	9	69.3		
Thermal	2	28.6	3	23.0	0.794	$^{MC}p = 0.133$
Chemical	0	0.0	0	0.0		
Electrical	1	14.2	1	7.7		
Degree of burn						
2nd superficial	3	42.8	12	92.3	5.934^{*}	$^{FE}p = 0.031^{*}$
2nd deep	4	57.2	1	7.7		
Color						
Red	6	85.7	13	100.0	1.955	$^{FE}p = 0.350$
Other	1	14.3	0	0.0		
Odor						
Yes	0	0.0	0	0.0	-	-
No	7	100.0	13	100.0		
Presence of granulation tissues						
Yes	7	100.0	13	100.0	-	-
No	0	0.0	0	0.0		
Local infection						
Yes	0	0.0	0	0.0	-	-
No	7	100.0	13	100.0		

□□: value for Chi square
FE: Fisher Exact test
MC: Monte Carlo test
* Level of significant at $p \leq 0.05$

N.S. Not significant difference

Part V: Comparison between two studied groups according to: -Hospital stay period, Cost of dressing and Time consumed during dressing. (Table XIII and XIV) and (Figure15)

¶ **Table (XIII):** Comparison between the two studied groups according to hospital stay

This table illustrates the comparison between the two studied groups according to hospital stay. The results revealed that mean of hospital stay to study group whom treated by ozone dressing techniques was 18.85±5.56 as compared to control group mean 23.0±5.34with significant difference 0.021^{*} at $p \leq 0.05$

So, there were significant different between study and control group in relation to the number of days in the hospital stay

Table (XIII): Comparison between the two studied groups according to hospital stay

Hospital stay (days)	Study (n = 20)	Control (n = 20)	T	P
Mean ± SD	18.85±5.56	23.0±5.34	2.407^{*}	0.021^{*}

t: Student t-test

*: Statistically significant at $p \leq 0.05$

Table (XIV): Relationship of both studied groups regarding to cost of dressing and time consumed during dressing .This table reveals the relationship of both studied groups regarding to cost of dressing and time consumed during dressing. It was found that, ozone therapy dressing technique represented the lowest cost of dressing. Mean was408.93±30.59 (LE) and the mean of time consumed was (0.68 ± 0.20), while, conventional dressing technique represented the highest cost of dressing(610.0 ± 80.34) and the mean of time consumed was(0.38 ± 0.28).

Table (XIV): Relationship of both studied groups regarding to cost of dressing and time consumed during dressing

	Study (n = 20)	Control (n = 20)
Cost of dressing (pounds)		
Range	338.0 – 699.50	500.0 – 700.0
Mean ± SD	408.93±30.59	610.0 ± 80.34
Time consumed during dressing		
Range / Min	30 – 60	0.33 – 0.50
Mean ± SD	0.68 ± 0.20	0.38 ± 0.28

V. Discussion

Burn injury has powerful effect on quality of life of victim suffering disability and financial loss. Burn injuries are one of the major health problems throughout the world. The problem of infection in burn wound is usually considered the direct cause of death in many burned patients.[1,35]

The recurrence rates of burn wound and risk of infection are high, with high mortality. Between 1 - 2 million Americans seek medical attention for burns each year. Most burns occur at home, at work, or are part of an injury from a motor vehicle accident The incidence of burn wound is about 50,000 - 70,000 people are hospitalized for burns every year in the United States may cause complications if not properly treated. [36]

Burn wound is predisposed to infection due to damage of the protective skin barrier, facilitating entry of saprophytes, and pathogens .In a addition, it involves a large amount of dead tissues that remain in place for a long period of time. Burn injury to the skin causes massive release of humoral factors, including cytokines, prostaglandins, vocative prostanoids, and leukotreines. Accumulation of these factors at the site of injury leads to micro-organism multiplication and colonizing wounds to high densities.[17,37]

Management of patients with burn wound can prevent the most serious complications. It is often challenging for both the patient and health care team exacting a physical, emotional, and financial status. In order to prevent these complications and promote healing the nurse needs to understand physiology of wound healing, as well as treatment modalities to be able to select the appropriate technique and solution for wound management. [34] The nurse who cares for a patient with a burn injury requires a high level of knowledge about the physiologic changes that occur after a burn, as well as astute assessment skills to detect subtle changes in the patient's condition. In addition, the nurse must be able to provide sensitive, compassionate care to patients who are critically ill and must initiate rehabilitation early in the course of care. The nurse must also be able to communicate effectively with burned patients, distract and supporting family members, and to cooperate with the entire interdisciplinary burn management team. This will ensure quality care, which increases the likelihood of the patient's survival and promotes optimal quality of life.[38]

Nurses are conducting nursing research and contributing to evidence-based practice of burn care. Practice guidelines, critical pathways and nursing care plans are all tools that help define and refine the nurse's role in burn care.[39] Evidence of effectiveness of nursing intervention has the potential to guide nurses in adopting practices based on research evidence rather than on tradition and beliefs and to improve the quality of care provided. Therefore, the nurses need up to date knowledge concerning managing burn wound with using appropriate strategies to control infection, wound healing and prevent recurrence to ensure sound decision making and successful out comes for those patients. [15,40]

Concerning, Ragab (2002), [19] Compared the effectiveness of two dressing technique; wet versus. Dry dressing technique on the healing process of recent moderate degree burns. Ragab concluded that wet method was more effective than dry method on the healing process. Up till now, the conventional dressing method is widely used although, the ozone olive oil ointment dressing method is not newly known. Therefore, the present study to determine the effectiveness of ozone therapy dressing technique on the healing process of recent ^{2nd} degree burns.

The last two decades have focused on improving wound healing rates and control infection by using different dressing techniques with different solutions such as honey (Api-care), dermagran wet dressing (zinc-saline) povidone –iodine (betadine10 %) and ozonated olive oil ointment.[14,15,23]

Ozone has been proposed as an antioxidant enzyme activator, immunomodulator and cellular metabolic activator. Ozone has a preventive effect in the development of fibrosis by decreasing tissue damage and increasing the antioxidant enzyme activity in an experimental model of injury.[41]

Biosocio-demographic and clinical data of the study subjects:

The results of the present study revealed that, no statistical difference between the study group I (ozone dressing technique) and the control group II (conventional dressing technique) regarding to biosocio- demographic data. Moreover, a convenience sample was included in the study.

As regarding to age it was found that the burned patients' ages were ranged 21<60 years, high percentage of burned patients were occurred at age 40 >50 year ,45.0% and 30.0% for study and control groups respectively. This finding is contraindicated with the finding of Abdel-hamid (2009)[7] who reported that the most common age groups of burn injury :were age18-25 years. However, the present study results were consistence with Burton et al (2009) [42] which revealed that patients had a mean age 45.2 years.

Regarding to marital status, the results illustrated that, studied patients in both groups were married (40.0%) this is congruent with Abbass (2009)[12] who state No Statistical significant differences between both studied groups.

As regard to gender, the present study showed that, the majority of patients in both studied groups were males. This is in the same line with Abdel hamid (2009) [7].

Regarding to occupation, patients in both groups (study and control) were manual working while, 40.0% had not working. The tables indicate no significance difference. This results may be due to majority of the worker in factories were male. So, their jobs necessitated exposure for long periods to dangerous, which increase risk for burn injury. These results are supported by Hewitt et al (2003) [43] who stated that, burn occurs most commonly in adults, also it affects younger. The adult worker males more affected than the adult females.

Regarding, the educational level more than one third of patients' in both studied groups were illiterate. So they may be not aware about the importance of safety environment to reduce risk of burn injury. These results were consisted with Smetltzer (2004) [44] who reported that burns occur related to work injuries. Moreover, these results were in agreement with Armstrong et al (2006) [45] who found that, illiterate patients were at risk for more than the educated patients as a result of lack of knowledge about infection and its complications.

Concerning to, vital signs the present study revealed that, abnormal vital signs at admission. No statistical significant difference between both studied groups regarding to Patients; (temperature, pulse, respiratory rate and systolic and diastolic blood pressure) were found at $p \leq 0.05$. The abnormalities in vital signs may be due to loss of skin function results in an inability to regulate body temperature of burned patients .This low body temperature occurs in the early hours post burn but as hypermetabolism resets core temperatures of burned patient become hyperthermia at post burn period even in the absence of infection. This results in the same line of Qsullivan T(1997)[46]. During hospitalization and after using ozone therapy. The results revealed decrease level of abnormalities of vital signs in study group. This finding may be due to following aseptic technique during dressing. Moreover, the ozone action (Ozone therapy is effective in the management of burned patients, its mechanisms are bactericidic, antihypoxic, antiflammatory, immunomodulating, detoxicating. It has direct fungicidal, bactericidal and virucidal effect). [26, 35,36]

Regarding Complete Blood Count profile (CBC):

The present study illustrated that, No Statistical significant differences between both studied groups in relation to all blood profile.

According to, CBC: hemoglobin, platelet, Red Blood Cell, White Blood Cell, Albumin and Hematocrite were abnormal until the end of first week but these testes were started to be normally gradually from the end of second, third week or before discharge. These results may occur as a result that burn injury induces the formation of thrombi with capillary, arterioles and venules due to activation of complement and coagulation

with damage RBC immediately after burn injury. These finding are consistence with Demling, R(2002) [47]At the time of burn injury some red blood cells may be destroyed and others damaged resulting in anemia .So, blood transfusions are required periodically to maintain adequate hemoglobin levels for oxygen delivery. [47]

Bocci (2006) [26] ascertained that ,the use of ozone dressing technique can affect the circulation through reducing and eliminating clumping of red blood cells and restores its flexibility along with oxygen carrying ,ability since clumping of red blood cells hinders blood flow through the small Capillaries and decreases oxygen absorption due to reduced surface area in circulatory diseases. Furthermore, Ozone oxidizes the plaques in arteries, allowing the removal of the break down products, unclotting the blood vessels. [26]

In the other hand, ozone dissolves in the plasma, it decompose in about one second and interacts with lipids, proteins, and carbohydrates, and generates a cascade of unstable and highly reactive oxygen intermediates among hydrogen peroxides and lipid oxidation products that allows its passive diffusions through the cell membrane from plasma so, hydrogen peroxides become the ozone messenger able to activate specific kinas by phosphor elating protein blocking. Nuclear factor Kappa B activity allows the migration of the transcription heterodimer into the nucleus and cytoplasm components leading to better oxygenation of the tissue. The effects of these oxygenation products extended up to 24 hours, and this explain the biological effects of ozone and its therapeutic actions. [48,49,50] Moreover ozone increases the flexibility of the red blood cells membrane which enhances the flow properties of blood thus, increasing the transport of oxygen to the cells and tissues.[51,52]

Regarding to body mass index (BMI), the results of the present study indicate no significant difference between the two studied groups on the admission or at discharge phase, so the two groups have desirable body weight. So, BMI not affected healing process. Calabro P (2007) [53] Campos AC (2008) [54] ascertained that, body mass index has relatively high correlation with estimates of body fatness and obesity hinder, process of wound healing.[46,47]

Burn wound assessment:

According to cause of burn, more than half of patients in both groups (study and control) were have scaled burn (65.0%). This finding was in agreement with Chien (2003)[55] who highlighted that the most of patients had scaled. Also these results advocated with American burn Association (2007,2009) [56,57] who reported that the main cause of burn in 90-95% caused by scaled.

Regarding to the morphology of the burn wound in the present study, most common **site** of wound in both studied groups were in hands. Occurrence of burn in this site, usually due to utilization of hands in each activity of any person. These results were congruent with Elmedany (2009) [58] his clinical study in management of dermal burned hand; the researcher may select this area because it is the most common site of burn.

As for the wound size at the initial assessment, the highest percentage of burn wound surface area in both groups was14-25% by using the rule of nine. These results also were in line with Abbas findings (2009)[12]. Moreover, Williams, et al (2009) [59], Romo and Pearson (2005)[60], Hinkle, B (2014)[61] stress upon the importance of measuring wound size and depth for determine healing outcomes for different wound types. Tennvall and Apelqvist (2001)[62] Ortegon ,et al (2004) [63] and Eneroth, et al (2004) [64] conclude that wound size, wound depth (penetration through to exposed tendon , ligament bone or joint), cause and the method of intervention are common variables that affect on healing process also stress upon assessment which consider most important factor for predicting outcome.[62-64]

Regarding burn degree (surface area), it was found that, the degree of burn wound of patients in the study and control group were the second degree that classified into 2nd superficial and 2nd deep. The majority of patients in both studied groups were the 2nd superficial degree. There were no statistical significant difference between both studied groups regarding degree at $p \leq 0.05$. This is related to research inclusion criteria of selection moderate burn injury.

The results of the present study revealed the absence of any significant differences in the biosociodemographic characteristics and wound characteristics (site, size, degree, and wound colour) between the study and control groups which insure limitation of the effect of any intervening variables and measure only the effect of the type of technique used in dressing on wound healing.

Regarding to wound pain during hospital stay period:

The results of this study revealed that, the pain in patients group managed by ozone dressing technique was mild in severity, it was tolerable by all patients statistical significant difference was found between two dressing techniques and wound pain after third week and before discharge at $p \leq (0.014^*, 0.041^*)$ respectively

Gonce P (2013) [3] and Reddy et al (2008)[65]. Stressed that; pain is a major factor in wound care that has to be managed before cleansing and dressing change. Because dressing removal had been identified consistently as the patient's experience of pain, most burned patients are less willing to tolerate wound care interventions. Ozone management providing analgesic. So, it is essential for managing that pain to relieve any associated discomfort during care.

As for abnormal wound healing:

The researcher observed decrease level of abnormalities or sign and symptoms of infection during the study and hospital stay period in study group while in the control group at the third week and four week, presence of some abnormalities such as increased of surface area of the wound or unchanged surface area of the wound and absence of healing epithelial edge were observed. In this aspect Jacobs et al (2007) [(66)] reported that, povidin-ioden (betadine 10%) solution may be used to clean wound but it retard it's healing. Also El sayad (2000)[(13)] illustrated that, high concentration of the povidon-ioden used in ulcer dressing leads to skin irritation. This finding may be due to the irritant effect of povidon-iodin. This findings was advocated by Abbass (2009)[(12)] and Williams (2008)[(40)] who emphasized that, daily dressing technique permit daily inspection of wound, thus any signs of inflammation or discharge is detected immediately and culture can be obtained to determine the type of microorganism and needed specific antibiotic to be prescribed.

As regarding to wound healing:

The present study indicated daily dressing permit daily inspection of the wound and assessment of wound for temperature, pulsation, color and skin abnormality. Carrougher (1998),[(34)] found that burn dressing as one that must protect wound, be comfortable allow gaseous exchange also, select dressing technique take into consideration depth of wound, site, cause and found that small blisters can be let intake but as a general rule , blisters should be debrideed and the wound dressed. Daily dressing is effective in healing process as a result of daily changing wound environment resulting in preventing the organisms to be colonized easily after implantation of two dressing technique.

The present study indicate that, the study group had not any necrotic tissue surrounding of burn compared to control group ,so the results indicate that ozone has debridement action.

Furthermore, the study group not have any signs of infection, these results are consistence with Tyagi (2005)[(28)] and Bocci [(67)] who reported that The surfaces of burned wounds in patients group managed by ozone therapy dressing technique not required surgical debridement due to rapid debridement's action .On the other hand there were slough on the burned wounds in patients group managed by conventional; dressing technique.[(28)] as a chemical and enzymatic process. Ozone reacts with several biological compounds of the cells especially the lipid in a process of lipid per oxidation where poly unsaturated fatty acid (PUFAs) produces ozonide, aldehydes and hydrogen peroxide leading to changing in fluidity, alteration in the ion transport mechanism, distortion of signal transduction and increased permeability that can causes break down of the cell components with cell lysis. Rapid debridement of the wound from the scar is the end result lead to early formation of healthy granulation tissues ratio. [(67)]

The results showed that, after the end of 2nd and 3rd weeks from the time of application of the ozone dressing technique it had significant effect on wound healing than conventional dressing technique. The number of patients who had partial wound healing was increased and the number of patients who suffering of abnormal wound healing was decreased. The progress of wound healing improved until the end of the hospital stay period. Patients who had completed healing increased more than those whom treated in the control groups. That illustrated by Ledea O (2007) [(68)] who referred the mechanism behind the promoting effect of ozone on reepithelization due to vasodilatation, enhanced oxygenation, normalization of tissue PH, reabsorption of edema ,active proliferation of fibroblasts and keratinocytes with excessive formation of fibronctin, collagen, chondroitin sulphate, intracellular matrix and stimulation the synthesis of cytokines. This explanation became evident to confirm the rapid progress of the wound healing in patients treated by ozone ointment. These results are the primary objective of researcher to fill the gap created by tissues destruction and to restore the structural of burned part.

At the end of hospital stay period, although the majority of patients in both studied groups had complete healing that means presence of healthy granulation tissue covered by migration and proliferation of epithelial cells within the wound space and formation of scar tissue, still the result of the study group patients is better than conventional groups since complete healing occurred in 65% of the study group and 35% had partial healing while, the healing for control group patients were 20% occur for them complete healing and 55% had partial healing.

The results of present study revealed that in study group, no patients complained of lacking wound healing this indicate that patients who treated with ozone dressing technique (ozone water, ozone olive oil ointment and by using bag) had better healing process. While in control group, five patients had incomplete healing at the end of hospital stay period.

These results were explained by EL Shinaway H.et al (2013) [(29)] who stated that, ozone ointment is more effective and help in rapid healing process. Also, the same author found that, in patients treated with ozone olive oil ointment complete wound healing was obtained after 6-21 days. Consequently stated that ozonated olive oil had a fungicidal and bactericidal effect; ozonized oil had been used locally for disinfecting lesions and promoting their healing.[(24)] In this field Lynch E (2008) [(69)] stated that ozone (O3), is an allotropic form of oxygen possess unique properties which are being defined and applied to biological systems as well as

to clinical practice as a molecule containing excess of energy, ozone manifests bactericidal, virucidal, fungicidal and healing promoting actions which make it a treatment of choice in certain conditions and an adjunctive treatment in others. [117] Also Seidler V et al, (2008) [70] ascertained that, ozone as a strong antimicrobial agent has haemostatic effects that stop bleeding, accelerates wound healing, activates immune system response. So, it has high antimicrobial activity ozone is most effective antibacterial and antiviral agents.[70] Bocci V . (2005)[71] added that Ozone improves oxygen supply in tissues and stimulate cellular metabolism and leading to rapid healing process. [71]

The researcher of the present study observed that, the study group had not any abnormality discoloration or exudates while in the control group more than half of the subjects had yellowish exudates at the time of discharge. Moreover one quarter of the control had sloughing area this may due to occurrence of infection and developing of necrotic tissues.

Relation between burned wound healing and biosocio-demographic characteristics:

The study results showed the presence of relation between wound healing in study group and some biosocio-demographic characteristics. The wound healing was better in patients with desirable body mass index, males less than 50 years, had small size, site and degree of burn. These results were in accordance with Willem (2011) [33] who reported that, age, sex, and patient's body mass index are considered the important factors in healing process. Moreover, Broughton (2006) [72] AlQahtani SM et al(2010) [73], Cha J& Falanga V (2007) [74] who reported that positive relation was found between the wound healing process and some of wound characteristics. The healing of wound was better when its size is small, superficial and the major sites were in hands. In this line, Eneroth, et al (2004)[64] concluded in their series papers that, wound size, duration (>two months) and wound depth (penetration through to exposed tendon, ligament bone or joint) were the three most important factors for predicting out come. There were significant relations were found between these factors and wound healing. These results may be due to the effect of other factors in healing such as, wound dressing and ointment used.

As regards to duration of hospital stay:

There were statistical significant differences between the two studied groups. The results revealed the mean duration of hospital stay were (18.85±5.56) in the study group while mean duration in conventional therapy group were (23.20±5.34) statistical comparison between the two groups showed that, duration of stay in hospital was significantly lower in group managed by ozone dressing technique than group managed by conventional dressing technique. This highlighted that, the cost of hospital stay of burned patient managed by ozone dressing technique is less than the cost of patient's managed by conventional technique this agreement with Elmadeny (2009)[58], Abbass (2009) [12] Bocci VA (2006)[26] and Azarpazhooh A(2008) [75]

As regard to cost and time consumed for dressing in the present study:

During the application of ozone water then used plastic bag and finally ozonated olive oil ointment dressing technique the researcher found that, the package of ozonated ointment can cover the wound dressing for more than one time. The dressings with ozonated ointment was less expensive than conventional dressing method and the healing period of the wound is faster but it consumed more time during dressing than other technique.

As shown from present study results, the ozone therapy dressing technique; ozone water and olive oil ointment is more effective than the conventional dressing technique on second degree of burn wound healing this results in the line with Calderon(2000)[76] Bocci (2006)[26] ,Azarpazhooh A(2008)[75], Travagli V (2010)[25], and EL Shinaway H (2013)[29] who highlighted that, Ozone therapy improve wound healing, modulate immune system, and act as an antibacterial agent.[76] So, the present study highlights the importance of using the ozone therapy dressing technique on second degree of burn wound it accelerate its healing promote epithlization and normal granulation tissues as well of better healing since prevent incidence of complications.

VI. Conclusion And Recommendations

Conclusion

From the present study, it can be concluded that although the two dressing techniques (ozone dressing technique and conventional dressing techniques) were effective on the healing process of second degree of burn wound dressing, ozone had faster healing effect than conventional dressing.

Recommendations

Based on the results of the present study, the following recommendations are suggested

- ozontaed water and Ozonated olive oil ointment recommended and be used on a daily based time to treat 2nd degree of burn wound.
- In the burn (out –patient clinics) it's preferable to use both dressing techniques in the management of patients with second degree burn

- Increase nurses' awareness about ozonated olive oil ointment dressing technique through:
- Development of procedure manual about ozone therapy.
- Training the nurses about how to use ozone ointment in dressing.
- Continuing education for nursing staff through in services training program to improve their knowledge about burn ,proper technique and solutions used in wound dressing, factors affecting healing and how to control wound infection

Suggestion for further studies:

- Study the effect of ozonated olive oil on infected wound
- Impact of using ozonated water instead of saline on wound 2nd and 3rd degree.
- Study to identify patients characteristics that affect the outcome of systemic ozone therapy (major &minor)
- Investigated the effect of the ozone in other unites such as using ozone in dentistry and dermatology fields.
- This study need to be conducted on large subjects and be extended for a longer period of time to allow generalization of the results.

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