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### RESEARCH ARTICLE

#### A COMPARATIVE STUDY OF THE EFFICACY OF NANOCRYSTALLINE SILVER WITH COLLAGEN BASE CREAM AND 1% SILVER SULFADIAZINE (SSD) CREAM ON THE HEALING OF BURN WOUND

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#### Abstract

**Background:**The aim of burn management is to prevent hypovolemic shock ,infection ,septic shock, to promote early epithelialization as well as healing of wound . The present study aimed to compare the effects of Nano crystalline silver with collagen base cream and 1% silver sulfadiazine cream on the healing of burn wounds.

**Materials & Methods:** A clinical prospective observational studyPatients with burn wounds were divided into two groups , one group was dressed with 1% silver sulfadiazine cream and the other group of patients was dressed with nano crystalline silver with collagen base cream. The wound dressing was changed everyday after washing the wound with normal saline. Wound parameters were assessed regularly , using clinical methods and photographs. The clinical data were statistically analyzed and results produced.

**Results:** In this department study ,using silver sulphadiazine cream &nano crystalline silver with collagen base cream , enhanced epithelisation& granulation tissue following decreased slough was observed and the results were better with nano crystalline silver with collagen base cream because of early and increased appearance of granulation tissue in the wounds & this was also proved by statistical analysis.The mean hospital stay was less in patients who were undergoing dressing with nanocrystalline silver with collagen base cream.

**Conclusions:** The effect of nanocrystalline silver with collagen base cream on the reduction of the healing time and necrotic tissue amount and increasing the granulation, epithelialization, and decreasing the necrotic tissue/slough was greater when compared to application of 1% SSD cream. Considering the above findings nanocrystalline silver with collagen base cream is more recommended to be used for burn wounds.

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**Introduction:-**

Over the past three decades, silver sulfadiazine (SSD) has become a very popular antimicrobial silver delivery system. All kinds of combinations of sulpha drugs with silver were tested in vitro, but SSD appeared to be the most effective and therefore used as a conventional dressing agent in burn wounds.

However, development of bacterial resistance and impaired reepithelialisation has been described. Side effects of SSD include fever, hepatic, and renal toxicity, rash, Bone marrow toxicity.

Nano silver particles have no local or systemic toxicity and do not impair wound healing.

Smaller the particle size of silver, greater contact with wound surface area, thus increasing bioactivity and silver solubility.

Silver in nanoscale affects the metabolism, respiration, and reproduction of microorganisms through connecting to the protein and the cell wall of microorganisms and influencing their phagocytosis process, which ultimately leads to the death of cells.

The collagen particles in cream stimulate & contribute to early wound healing.

Due to strong antibacterial activity, nanosilver is used for the treatment of wounds, including burn, because it can reduce the recovery time and relieve inflammation.

In this study, we shall compare the efficacy of nano crystalline silver with collagen base cream and 1% silver sulphadiazine cream in the management of burn wounds.

**Materials & Methods:-****Study Design:**

A Prospective Observational Study

**Study Duration:**

12 months (APRIL 2023 TO APRIL 2024)

**Aim of the study:-**

To analyse & compare the efficacy of the nano crystalline silver with collagen cream with 1% SSD cream in the treatment of burn patients in a tertiary care center.

**Inclusion criteria:**

All patients with burn injury admitted in the department of plastic surgery.

**Exclusion criteria:**

1. children less than 12 years of age and patients older than 60 years of age.

**Study Design:**

A prospective, hospital based observational study involving observation of patients from admission to final outcome of management at discharge or death & follow up for 6 months.

Patients presenting to the hospital with burn injury will be admitted & will be resuscitated and stabilized and will undergo clinical examination and below mentioned investigations following which information regarding the mode of presentation, relevant history, signs and symptoms, treatment offered will be collected in a pretested, semi-structured proforma cum observational check list and followed up by telecommunication.

**Investigations required:**

Hemoglobin percentage, Renal function tests, Liver function tests, Total and differential WBC count, ECG, Blood grouping, HIV/HBsAg, Abdominal and chest X-ray erect and supine, Ultrasonography abdomen, Bleeding time

&Clotting time, 3D CT FACIAL BONES & ctangio lower limb , colour Doppler of bilateral lower limb, COMPLETE URINE ANALYSIS.

Various clinical data like age , gender, etiology ,evaluation & extend of burns, dimensions of burn injury & depth & degree of burns, time interval between burns & surgery, the ointment applied , time taken for surgery, time period in ICU and duration of hospital stay and any deformity ,disability and morbidity are collected and correlation analysis is made in this study.

### Results:-

In this study 248 patients were studied in the time period of 12 months.

The 248 patients were divided randomly (based on available resources in the hospital) into 2 group's:-

1. nano crystalline silver with collagen cream (NSC) group : 118 patients
2. 1% silver sulphadiazine cream (SSD) group : 130 patients

Distribution of burns cases of our department as per the percentage of burns.

S.NO	GROUP	% OF BURNS	NO OF PATIENTS	Average hospital stay (day's)
1	NSC	Less than 15% burns	38	9.6
2	SSD	Less than 15% burns	40	13.3
3	NSC	15% to 30% burns	67	14.6
4	SSD	15% to 30% burns	60	17.9
5	NSC	30% to 50% burns	25	27.5
6	SSD	30% to 50% burns	15	32.6
7	SSD	More than 50% burns	03	37.5

The average hospital stay corresponds to the time taken for the wounds to heal.

In the "Less than 15% burns " category, in the NSC group the average hospital stay is around 9.6 days & in the SSD group the average hospital stay is around 13.3 days.

In the "15% to 30% burns" category , in the NSC group the average hospital stay is around 14.6 days & in the SSD group the average hospital stay is around 17.9 days.

In the "30% to 50% burns" category , in the NSC group the average hospital stay is around 27.5 days & in the SSD group the average hospital stay is around 32.6 days.

### Review of data

Group	NSC	SSD
Mean	17.233000	21.266000
Standard Deviation	9.235900	10.081000
Standard Error of Mean	0.850234	0.884162
N= total patients	118	130

Unpaired t test results

P value and statistical significance:

The two-tailed P value is less than 0.005  
By conventional criteria, this difference is considered to be significant.

In the “More than 50% burns” category , they were included in SSD group and the average hospital stay is around 37.5 days.

In the NSC group , out of 118 patients 76 patients were males (64.4%) & 42 patients were females (35.6%).

In the SSD group , out of 130 patients 86 patients were males (66.1%) & 44 patients were females(33.8%).

#### Distribution of burns patients depending upon wound characteristics

Wound character	NSC(n=118)	% of total	SSD(n=130)	% of total
Decreased slough	108	91.5	105	80.7
Decreased infection	106	89.8	104	80
Increased epithelialization	105	89	102	78.5
Increased granulation	98	83	90	76
Decreased inflammation	98	83	90	76

There is decreased slough formation & decreased infection with the use of both Nano crystalline silver with collagen base cream and 1% silver sulfadiazine cream .

There is more increased epithelisation , increased granulation tissue formation, decreased inflammation following dressing with nanocrystalline silver with collagen base cream NSC group when compared to 1% silver sulfadiazine cream SSD group.

Hence, we shall test the findings for statistical significance by comparing the results of our study findings.

#### Review of data

Group	NSC	SSD
Mean	87.260000	78.240000
Standard Deviation	3.990000	2.193800
Standard Error of Mean	0.367309	0.192409
N= total patients	118	130

Unpaired t test results

#### P value and statistical significance:

The two-tailed P value is less than 0.005  
By conventional criteria, this difference is considered to be significant.

Hence , Considering the above findings nanocrystalline silver with collagen base cream is more effective & efficient & more recommended to be used for burn wounds.

#### Discussion:-

Following hypovolemic shock , Infection/sepsis is the most common cause of mortality & morbidity in burns patients in our institute. antibacterial creams application topically , in the immediate post burn period, is an effective measure which can prevent infection & sepsis & multiorgan dysfunction syndrome (MODS) & death & promote the healing of wounds.

Silver ions (Ag<sup>+</sup>) & nanocrystalline silver ions have antimicrobial activity due to the following four mechanisms:-

1. bacterial cell membrane binding & consequent damage & interference with various receptors,
2. Alteration of production of ATP by bacterial electron transport disruption.
3. Bacterial DNA binding & consequent impairment of cell replication

4. Interference in the building up of intracellular building blocks by formation of insoluble intracellular compounds involving nucleotides, proteins and the amino acid histidine.

**Nano silver:-**

In Nano Crystalline Technology of silver ,nano particles of silver are attached onto – polymers or fibers& consequently increasing the surface contact area of the silver so that more silver interface with the wound surface , of the aqueous environment. This increased wound interface of silver is the significant mechanism in wound infection eradication.

**Collagen:-**

Collagen in cream deactivates matrix metalloproteinase (MMP's) and encourages wound healing by formation of collagen fibers, granulation tissue formation, angiogenesis. Collagen acts as sacrificial substrate to matrix metalloproteinase (MMP's) and helps in formation of body own collagen which is major component in extra cellular matrix. Collagen reduces pain, soothes and deodorizes the wound.

**Nano crystalline silver with collagen formulation cream :-**

Nano crystalline silver with collagen formulation cream has more effective anti-microbial action with efficacy 99% within 1 minute of application.

Nano crystalline silver with collagen formulation cream conforms to any wound site & reduces pain, soothes & deodorizes the wound.

This Nano crystalline silver with collagen formulation cream is not only highly absorbant and also decreases evaporation of fluid .In moist wounds nearly eight to ten times its weight in fluid is absorbed , if wound is dry it contributes TO moisture maintainence& decreases scar formation by improved wound healing in dry wounds.

Nano crystalline silver with collagen formulation cream is biocompatible & biodegradable, easy to handle and deliver.

**Silver Sulfadiazine:-**

Once or twice daily application of this water soluble 1% Silver Sulfadiazine cream is effective for optimal wound care. After several applications this ointment may interfere with wound status assessment because of wound bed discoloration (pseudoeschar). 1% SSD cream soothes on application and causes no pain. Silver Sulfadiazine 1% cream penetrates eschar poorly<sup>21</sup>. 1% Silver Sulfadiazine cream has significant antimicrobial activity including pseudomonas microbes also.<sup>2,21</sup>

In this department study ,using silver sulphadiazine cream &nano crystalline silver with collagen base cream , enhanced epithelisation& granulation tissue following decreased slough was observed and the results were better with nano crystalline silver with collagen base cream because of early and increased appearance of granulation tissue in the wounds & this was also proved in Wright et al study .<sup>21</sup>

**Conclusion:-**

With the increasing incidence of multidrug resistant superbugs , the burn wound infection prevention & decreasing sepsis is difficult & extremely important. There is a very large demand for topical bactericidal agents for prevention of burn wound infection. With the increasing understanding of pathophysiology of burn wound & with the increasing awareness of common people & with development of first aid & emergency disaster or accident protocols ,the prevention & of burn wounds management protocols are standardised are proving more efficient. The effect of nanocrystalline silver with collagen base cream on the reduction of the healing time and necrotic tissue amount and increasing the granulation, epithelialization, and decreasing the necrotic tissue/slough was greater when compared to application of 1% SSD cream<sup>21</sup>. Considering the above findings nanocrystalline silver with collagen base cream is more recommended to be used for burn wounds. In the future, newer modalities of dressings & cost-benefit analysis of newer modalities of dressings are to be studied.



Post burn day 4 of burn wound dressed with NANOCRYSTALLINE SILVER WITH COLLAGEN BASE CREAM



POST burn day 8 of burn wound treated with NANOCRYSTALLINE SILVER WITH COLLAGEN BASE CREAM

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