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Role of Topical Feracrylum in Management of Second Degree Scald Burns

Nivetha[1], Ravi Kumar Chittoria[2], Bharath Prakash[3]

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ABSTRACT

Partial and deep partial thickness burn wounds present a difficult diagnosis and prognosis. Management of burn wound inflicted by the different physical and chemical agents require different regimes which are poles apart from the regimes used for any of the other traumatic wounds. In extensive burn, because of increased capillary permeability, there is extensive loss of plasma leading to shock while whole blood loss is the cause of shock in other acute wounds. Even though the burn wounds are sterile in the beginning in comparison to most of other wounds, yet, the death in extensive burns is mainly because of wound infection and septicemia, because of the immunocompromised status of the burn patients. Current techniques of burn wound care have significantly reduced the incidence of invasive burn wound infection, altered the organisms causing the infections that do occur, increased the interval between injury and the onset of infection, reduced the mortality associated with infection, decreased the overall incidence of infection in burn patients, and increased burn patient survival.

Feracrylum, a water-soluble combination of partial ferrous salts (II and III) of polyacrylic acid, is one of the chemical hemostatic agents and an antibacterial agent. Its molecular weight ranges from 500,000 to 800,000 Daltons, which prevents systemic absorption and prevents any negative effects on the liver, kidney, adrenals, cardiovascular, or hemostatic systems. Feracrylum has antibacterial properties, which lowers the risk of wound infection.

Keywords: Topical; Feracrylum; Management; Second degree scald burns.

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INTRODUCTION

A variety of factors guides the evaluation and management of burns. First is the type of burn such as thermal, chemical, electrical or radiation. Second is the extent of the burn usually expressed as the percentage of total body surface area (%TBSA) involved. Next is the depth of the burn described as superficial (first degree), partial (second degree) or full thickness (third degree).[1] Finally, other factors include specific patient characteristics like the age of the patient (< 10 or > 50 years old); other

medical or health problems; if there are specialized locations of the burn (face, eyes, ears, nose, hands, feet and perineum); and if there are any associated injuries, particularly smoke inhalation and other traumatic injuries.

Burn wound infections can be classified on the basis of the causative organism, the depth of invasion, and the tissue response.[2] Diagnostic procedures and therapy must be based on an understanding of the pathophysiology of the burn wound and the pathogenesis of the various forms of burn wound infection. The time related changes in the predominant flora of the burn wound from gram-positive to gram negative recapitulate the history of burn wound infection. Burn wound infections can be classified on the basis of the causative organism, the depth of invasion, and the tissue response.[3] Diagnostic procedures and therapy must be based on an understanding of the pathophysiology of the burn wound and the pathogenesis of the various forms of burn wound infection.[4] The time related changes in the predominant flora of the burn wound from gram positive to gram negative recapitulate the history of burn wound infection.[5]

MATERIALS AND METHODS

As pilot research, the investigation was carried out in a higher education facility in july 2023. The research was entirely descriptive; no statistical analysis was carried out. After gaining informed consent, the patient with the scald burn (Fig. 1) was included. The patient was 3 years old admitted for second degree scald burns. Feracrylum in solution form was used as antimicrobial solution (Fig. 2). Serial changing of dressings of the burns wound was done.

RESULTS

In this study, we had a child with second degree scald wounds due to boiling water. The wound at the end of 3 weeks (Fig. 3) showed a significant reduction in treated area measured by digital planimetry with a new epithelium development. After treatment, the size of the raw area surface decreased (Fig. 3). Due to the application of feracrylum no pain, soaking was observed, good hemostasis and no infection was observed.

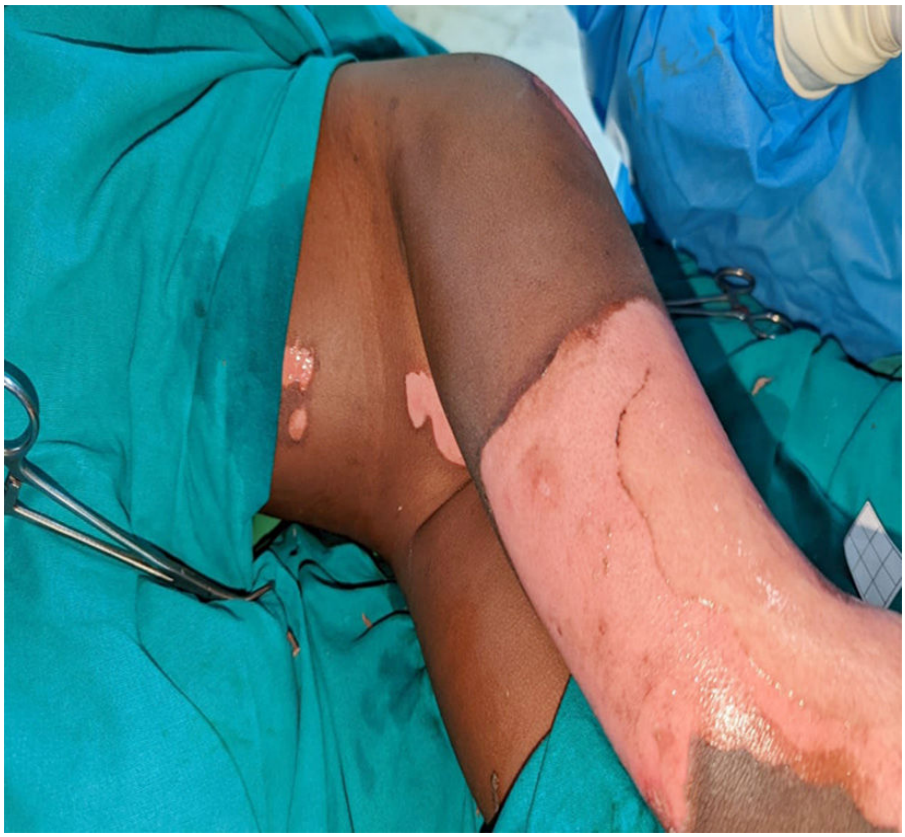

Fig. 1: Wound at Presentation

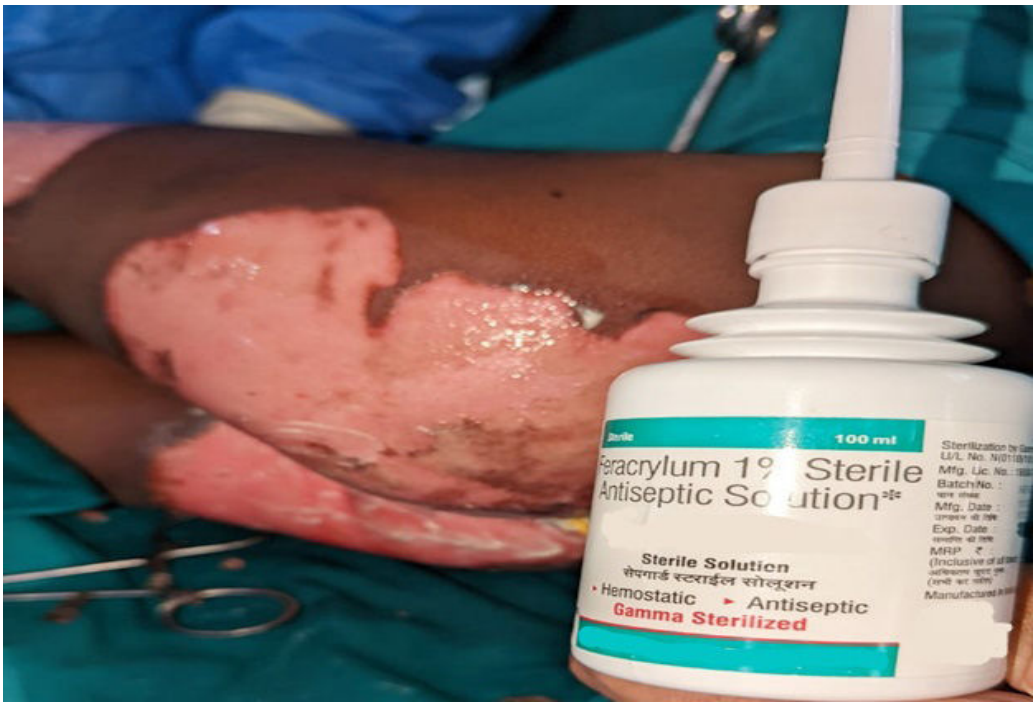

Fig. 2: Application of feracrylum over burn surface

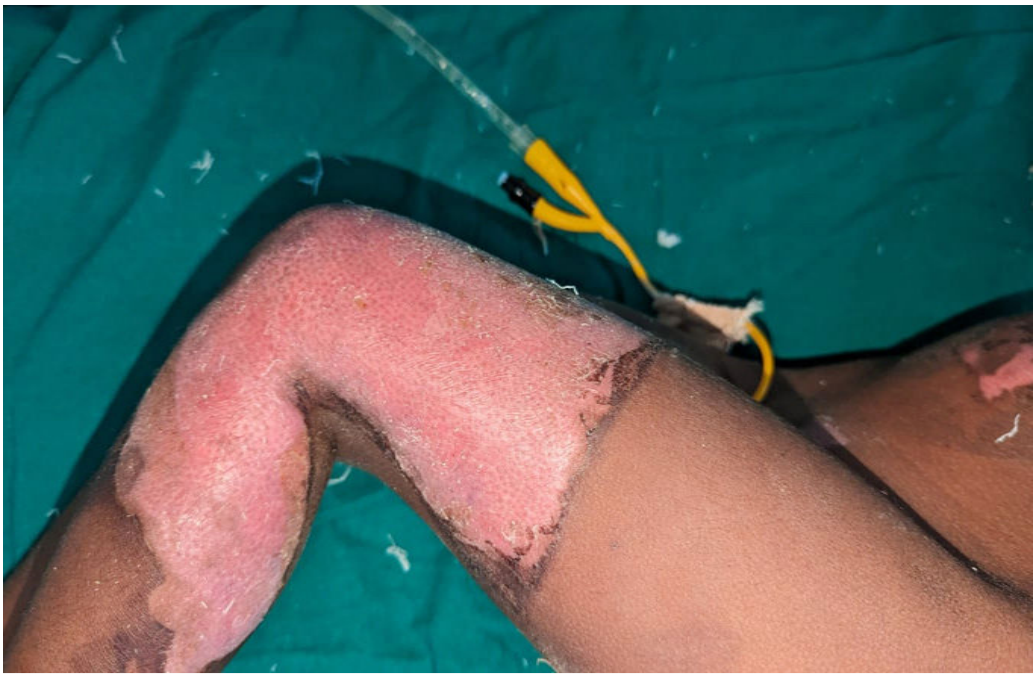

Fig. 3: Healed second degree superficial burns

DISCUSSION

Feracrylum is a water soluble mixture of incomplete ferrous salt II and III of polyacrylic acid containing 0.05–0.5% of iron. It is biodegradable and hygroscopic.[6] The molecular weight is about 5,00,000–8,00,000 Daltons, due to which there is no systemic absorption. No noted side effects on major organs like liver, kidney, adrenal gland,

cardiovascular system and hemopoietic system. It has antimicrobial and wound healing properties.[7]

Feracrylum has multiple actions for wound care

Antimicrobial action: Feracrylum is not only haemostatic but also anti-infective against a number of Gram-positive and Gram negative pathogenic, bacterial and fungal strains like

Staphylococcus aureus, Streptococcus pyogenes, Corynebacterium diptheriae, Salmonella typhi, Shigella dysentriae, Pseudomonas aeruginosa, Proteus vulgaris, Escherichia coli.

Trichoderma viridae and Candida albicans.[10]

It ruptures microbial cell wall causing cell lysis. Feracrylum is superior to povidone iodine for its antimicrobial properties and its efficacy is comparable to that of povidone iodine.[11]

Feracrylum decreases risk of wound infection which delays wound healing.

Hygroscopic action: Feracrylum is hygroscopic in nature and maintains a moist environment at wound site resulting in faster healing and easy dressing removal. It promotes growth of healthy granulation tissue. Feracrylum is available in the form of a solution (1% w/v feracrylum), gel and tubes (1% feracrylum) and tulle (3% feracrylum).

Haemostatic action**:** It causes activation of thrombin (factor IIa) which is a serine protease that converts soluble fibrinogen into insoluble strands of fibrin thus forming clot as well as catalyzing many other coagulation related reactions in blood coagulation.[8]

Also, feracrylum on coming in contact with blood proteins especially albumin, it forms a biodegradable water insoluble synthetic complex creating a large rubbery clot which forms a physical barrier on wound surface and stops capillary bleeding and oozing in 2-3 minutes. It is non allergic with no systemic absorption.[9]

CONCLUSION

The present study, results may conclude that better size reduction of raw area (high percentage of epithelized area) and lesser incidence of wound infection when Feracrylum was used.Topical feracrylum can be used to manage burn wounds with satisfactory results. The time taken by the patients to recover from pain, resume their normal activity and also with regard to normal food intake was rapid.

It is a good topical agent for prevention of infection of the burn wounds. Further studies are recommended with large sample size to confirm these findings.

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Management of Perineal Scald Burn in a Tertiary Care Hospital: Our Experience

Walunj Sachin Dnyaneshwar[1], Ravi Kumar Chittoria[2], Barath Kumar Singh P[3]

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ABSTRACT

Burns to the perineum and buttocks are difficult to heal for a number of reasons, including the constant threat of contamination and shear stress. Pathogens can easily penetrate the wound bed and induce systemic infection. Patients' recovery is further delayed by lengthy healing times, which increases their pain and psychological stress as a result of the injury. Though they are rare, significant burns to the lower trunk and lower limbs can also involve the external urethra, penis, labial tissues, anal opening, and distal rectal mucosa. In this case report, we discuss the management of perineal burn wounds in our center.

Keywords: Management; Scald; Burns; Perineum.

INTRODUCTION

Burns to the genitalia and perineum have detrimental effects on a person's quality of life in terms of their physical, functional, sexual, and psychological well-being.[1] Because of the severity of these burns, both the patient and the treating surgeon are very concerned about them.[2] As the thighs and lower abdomen protect this area from severe burns, fortunately, these burns are not as common as they may be. These patients usually experience a lengthy hospital stay that is linked to high morbidity and elevated mortality. In essence, rather than the perineal burn specifically, the prolonged institutional stay and high mortality represent the severity of trauma.[3] The purpose of this study was to report our experience with the management and outcome of perineal burns at our burn center in a tertiary care hospital in Southern India.

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MATERIALS AND METHODS

This study was conducted in the Department of Plastic Surgery in a tertiary care center in South India after obtaining the departmental ethical committee approval. Informed written consent was taken from the patient. 3-year-old girl had scald burn injury when accidental self-fall into hot water where in she sustained injuries to perineum,

bilateral gluteal region and genitals (Fig. 1). Patient was admitted with the above symptoms and managed according to WHO burn protocol and IBSI protocol. She underwent Wound debridement

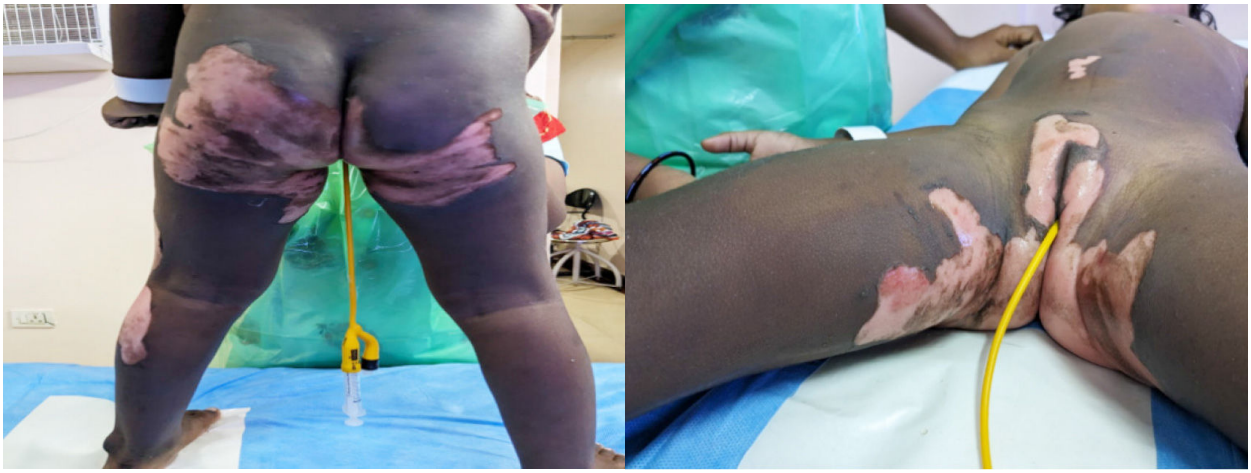

Fig. 1: Perinealscald burns at presentation

and hydrotherapy. The wound debridement was done with mechanical dermabrasion (Fig. 2). Feracrylum solution was used to clean the wound to prevent infection as the region is more prone for infection (Fig. 3). The wounds were managed with Regenerative therapies like Autologous Platelet Rich Plasma, collagen scaffold application with silver-based ointment, Negative Pressure

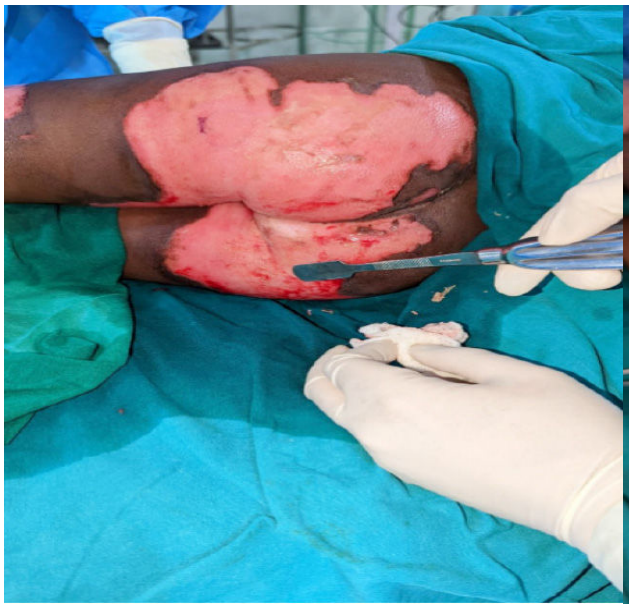

Fig. 2: Mechanical dermabrasion assisted tangential excision

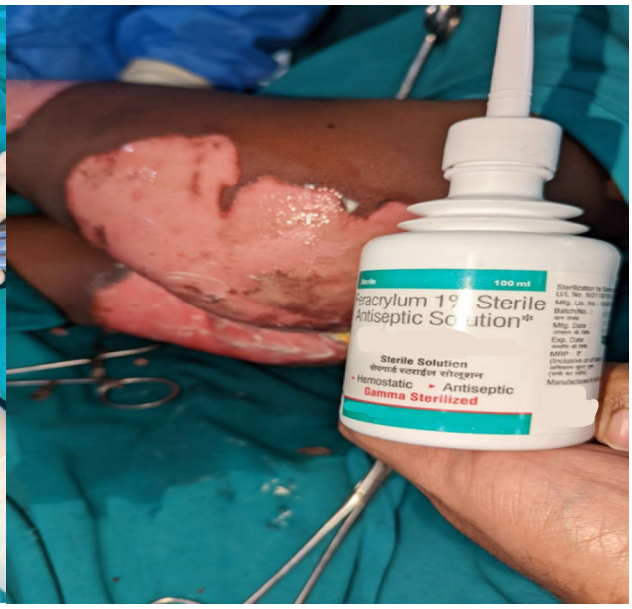

Fig. 3: Feracrylum 1% in burn wounds

wound therapy (Fig. 4-6). Once wound showed promising signs of healing and epithelization was complete, we applied Silicone gel and silicon sheet over the healed wound to prevent the abnormal scarring. We also used low-level laser therapy and autologous platelet rich plasma every week for 3 weeks till complete healing of the burn wounds.

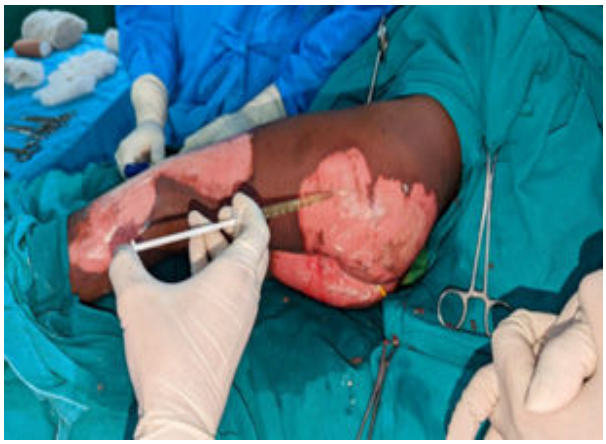

Fig 4. Autologous platelet rich plasma therapy

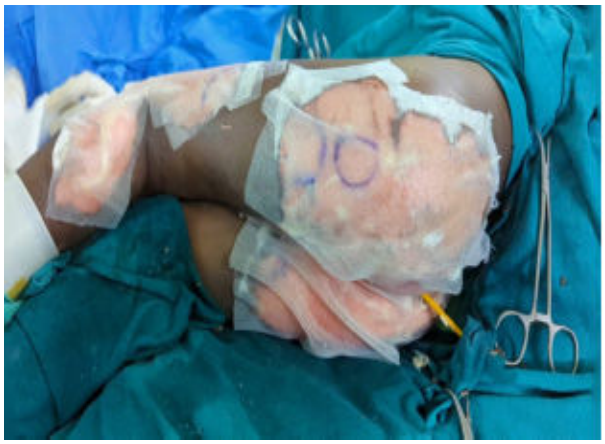

Fig 5. Collagen application

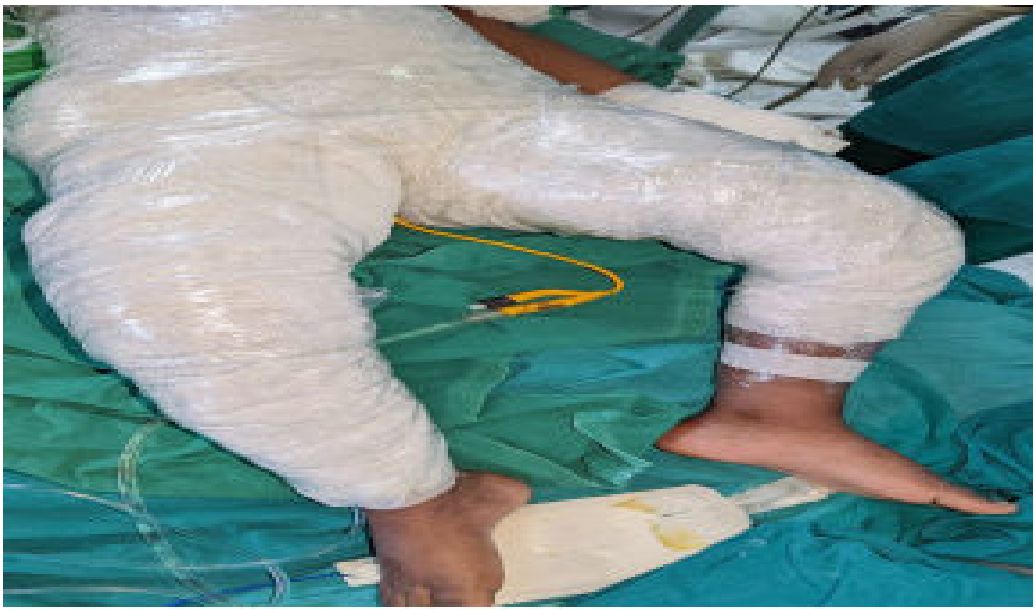

Fig 6. Negative Pressure Wound Therapy

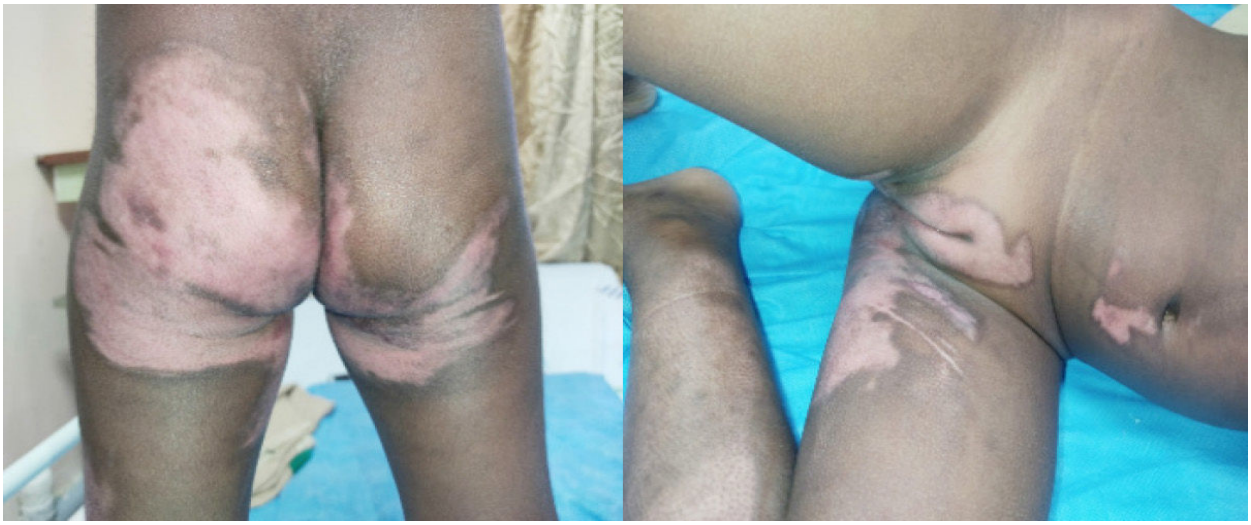

Fig 7. Healed burn wound at discharge

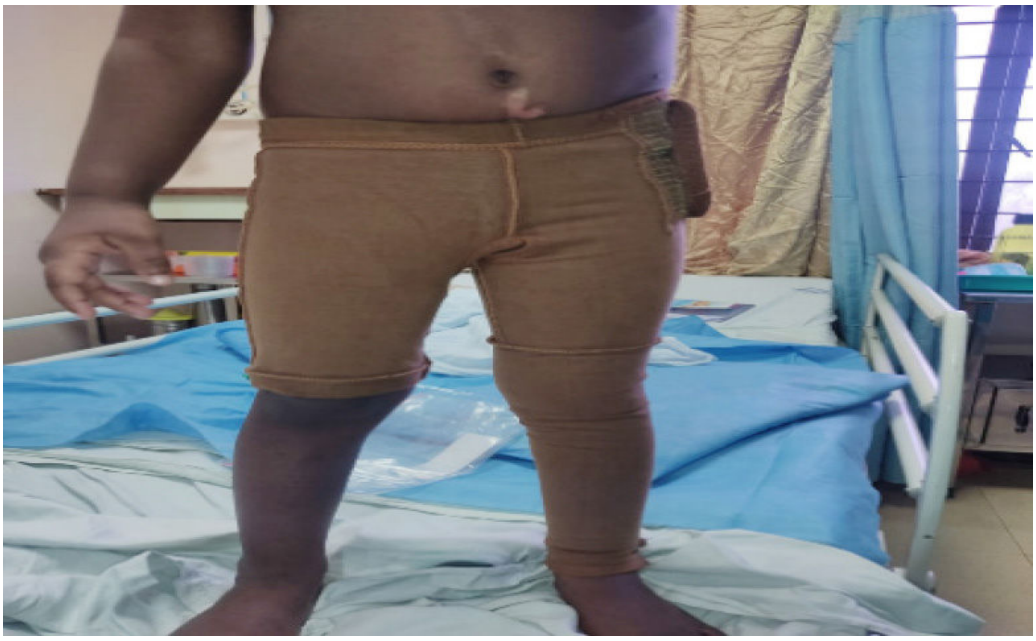

Fig 8. Pressure garment at discharge

RESULTS

Patient burn wounds healed and there was minimal abnormal scarring and no hypertrophic scarring at the time of discharge (Fig. 7). Pressure garment was provided at the time of discharge (Fig. 8). Vancouver Scar Scale - 3/13 at the time of discharge.

DISCUSSION

Burns to the perineum and genitalia can potentially impair or destroy function, aesthetics, and the ability to maintain proper hygiene. The loss of normal tissue and scarring can limit movement, and cause pain, disfigurement, and social embarrassment. Surveillance for preservation of genitourinary and sexual function is a component of the treatment plan. The initial management of patients with superficial and deep burns to the perineum and genitalia prior to any potential surgical management is conservative, including cleansing, gentle gauze debridement of loose burned tissue if present, and coverage with topical antimicrobial agents and dressings. The wound healing rate with conservative measures ranges from approximately 80 to 96 percent.[2]

For patients with substantial burns involving the perineum and/or genitalia alone, or including the inguinal or lower truncal areas, the management is more complex. The thighs should be maintained at 15° abduction to facilitate healing and dressing changes. In addition to local topical agents and dressings, the initial management of the extensively burned patient also includes protecting the urethral meatus from obliteration due to swelling and protecting the burned skin from urinary and fecal contamination.[2,3]

Autologous platelet rich plasma is an upcoming and proven treatment modality for patients with burn injuries wherein concentrated platelet preparations are used which enhance body regenerative process. Several kinds of bioactive mediators, including immunological mediators, clotting factors, chemokines, integral membrane proteins, adhesion proteins, growth factors, and clotting factors, are stored and prepared to react to tissue injury inside the cytoplasmic granules of platelets. In wounds treated with PRP, the bioactive mediators have a favorable impact on cellular development, proliferation, differentiation, and re-epithelialization by promoting angiogenesis, mitogenesis, and controlling the endogenous inflammatory process.[4] The advantage of allogeneic PRP is that it can be obtained from willing blood donors, and its derivatives can be used right away without the requirement for clinicians to get a patient sample. In some clinical circumstances, such as those involving acute burns when patients may be fluid depleted and thrombocytopenic, this may be helpful. Other conditions that preclude

the creation of PRP include hemophilia, sepsis, or infection; related contraindications include the use of NSAIDs or corticosteroids, tobacco usage, malignancies, and anemia.

LLLT, which can trigger photochemical reactions in tissue and cells, is sometimes referred to as biological stimulation or photobiological regulation. Previous research has demonstrated that LLLT affects the photoreceptors on mitochondria, stimulates the electron transport chain of produced energy, enhances mitochondrial respiration, and boosts the synthesis of adenosine triphosphate (ATP). As a result, LLLT has the ability to change the cellular redox state and to trigger the activation of signaling pathways that drive transcription factors involved in proliferation, tissue repair, and regeneration.[5]

The various dressings and tissue-engineered constructions used in burn therapy depend heavily on biomaterials. The major goal of employing them is to mimic the skin's ECM, which is composed of laminin, elastin, collagen, and proteoglycans. Laminin gives the skin strength, while proteoglycans give it moisture and viscosity. Biomaterials of diverse origins are employed in skin grafts and substitutes, and the decision made during scaffold manufacturing is crucial because it can affect in situ regeneration. These materials' characteristics control cell behavior and facilitate the development of new tissue. Biodegradability, momentary mechanical support, and permeability are the primary needs. Scaffolds can be either with or without cells, and the latter can be further broken down into dermal, epidermal, and epidermal-dermal composites depending on the methodology.[6]According to theory, negative pressure might generate an interstitial gradient shift that can reduce oedema and, as a side effect, promote cutaneous perfusion, facilitating the evacuation of blood or serous fluid. Additionally, it is hypothesized that NPWT's capacity to generate a mechanical stress or force that directly influences cellular activity, particularly the growth of new blood vessels, may help slow the advancement of burn wounds. Additionally, it may be desirable to maintain a wet environment that offers ideal circumstances for epithelialization and prevents tissue desiccation.[7]

The skin surface temperature of hypertrophic burn scars under SGS is increased by 1.7°C, and temperature increases of this magnitude can significantly increase collagenase activity and could affect scarring. As a result, it is possible that an increase in skin surface temperature is involved in the mechanism of action of silicone based products for scar management. Because it has been suggested that the negative static electric field produced by friction between SGS and the skin may cause collagen realignment and lead to the involution of scars, the development of a static electric field may also be implicated.[8]

The way feracrylum works is by building water-insoluble multi-complexes with different proteins, including those found in blood. The hemostatic effect of feracrylum is given through the creation of a synthetic complex on the wound surface that consists of its adduct with plasma proteins, primarily albumin. The in-vitro mixture of feracrylum and serum albumin results in a substantial rubbery clot. The feracrylum-albumin combination degrades over time like all other biodegradable polymers. After that, these subunits are ejected. The benefit of feracrylum is that it combines antibacterial activity with little local toxicity or irritation, making it useful in preventing acute, chronic, and hospital infections, especially in post-operative wounds, and facilitating wound healing.[9]

CONCLUSION

With advent of newer technologies, treatment of scald burn wounds has been much more streamlined and produce better results in patients. In our experience we have seen better wound healing in patient with scald burns with minimal scarring. However large randomized control trials are necessary to establish association between the same.

Conflicts of interest: *None*

Disclosures: *None*

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Wound Infection Prediction Score

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ABSTRACT

There are currently no clear cut guidelines available to help clinicians discern whether a chronic wound is infected or prone to infection. Similarly, there are no established guidelines to assist in determining when systemic antibiotics are necessary or how long they should be administered. This absence of widely recognized guidelines may result in the overuse and misuse of systemic antibiotics, potentially leading to adverse drug reactions and the emergence of multidrug-resistant bacteria. Introducing a straightforward tool for assessing infection risk in patients with chronic wounds could aid clinicians in deciding when systemic antibiotics are warranted and in ensuring their appropriate use, ultimately possibly curbing the overreliance on such medications.

This study highlights the role of W.A.R. score as a wound infection prediction score.

Keywords: W.A.R.; Score; Wound; Prediction; Infection.

INTRODUCTION

Chronic wounds are associated with a significant increase in health care utilization and health care costs,[1] increased morbidity and mortality,[2] and decreased quality of life.[3] In addition, patients with chronic wounds have more exposure to systemic antibiotics compared with patients without chronic wounds, putting them at a higher risk for developing multidrug-resistant organisms (MDROs) and other adverse events.[4] Because of this, it is vital for health care providers to identify when a chronic wound is at risk for infection to avoid both the overuse and underuse of systemic antibiotics.[5] Despite this, no widely accepted guidelines exist to assist clinicians in determining when a chronic wound is infected or at risk for infection, nor do definitive guidelines exist to aid the clinician in determining the indication or duration of systemic antibiotics.[6,7] This ambiguity can lead to excessive and improper use of systemic antibiotics, which then contributes to adverse drug events (ADEs) and the development of MDROs in not only the patient but also in the community.[7] The Wounds at Risk (W.A.R.) score (Fig. 1) is a tool used to assess the risk of infection in patients by scoring a number of host factors that can contribute

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to an increased risk for infection in wounds. Implementing this simple tool could help clinicians determine the indication and appropriate use of systemic antibiotics and potentially reduce the use of systemic antibiotics in this patient population.

The Infectious Diseases Society of America (IDSA), the British Society for Antimicrobial Chemotherapy, and the European Wound Management Association all concur that no universally accepted diagnosis criteria for an infected chronic wound exists.[6,7,8] They also agree that the traditional signs and symptoms of infection include redness (erythema/rubor), warmth (calor), purulence, swelling or induration (tumor), and tenderness and pain are not always present in infected chronic wounds.[7,8] In fact, in the IDSA's guidelines for the diagnosis and treatment of diabetic foot infections, the presence of at least 2 of these symptoms is enough to both diagnose a diabetic foot infection and treat with systemic antibiotics, but the authors of the guidelines warn that these diagnostic criteria are based solely on expert opinions and not evidence.[8]

This study highlights the role of W.A.R. score as a wound infection prediction scores

MATERIALS AND METHODS

This study was conducted in a tertiary care hospital in South India after obtaining department's scientific & ethical committee approval. Informed consent was taken from the patient & attendants. The W.A.R. score was applied on a left trochanter pressure ulcer (Fig. 2) and score was 6 at the time of admission.

Since the W.A.R score was more than 3,

Risk Class	Risk Condition	Yes	Per Risk: 1 Point
1	Acquired immunosuppressive disease (eg, diabetes mellitus)		
	Acquired immune defect due to medical therapy such as cyclosporine, methotrexate, glucocorticoids, or antibodies		
	Solid tumor disease		
	Systemic hematological disease		
	Postsurgical wound healing disorder, which results in (unplanned) secondary healing		
	Problematic hygienic conditions related to social or occupational environment		
	Patient age >80 years		
	Young patient age (premature infants and infants)		
	Wounds persisting >1 year		
	Wound dimensions >10cm²Chronic wounds of any etiology having a depth of >1.5cm		
	Extended inpatient status >3 weeks		
			Per Risk: 2 Points
2	Severe acquired immune defects (eg, HIV infection)		
	Heavily contaminated acute wounds		
	Bite, stab, and gunshot wounds penetrating 1.5cm-3.0cm		
			Per Risk: 3 Points
3	Severe innate immunodeficiency (eg, Wiskott-Aldrich syndrome, DiGeorge syndrome, immunodeficiency after stem cell transplantation, AIDS, immunosuppressive therapy)		
	Traumatically contaminated wound after debridement		
	Wounds that have a direct connection to organs or functional structures (eg, joints) or which contain foreign material (eg, prothesis)		
		Total Score:	
WAR Score <3 Patient not at increased for wound infection; systemic antibiotics may NOT be indicated			
WAR score ≥4: Patient is at increased risk for wound infection; systemic antibiotics may be indicated			
WAR: Wounds at Risk for infection			

Fig. 1: Parameters for Calculating W.A.R score[1]

appropriate antimicrobial therapy was started.

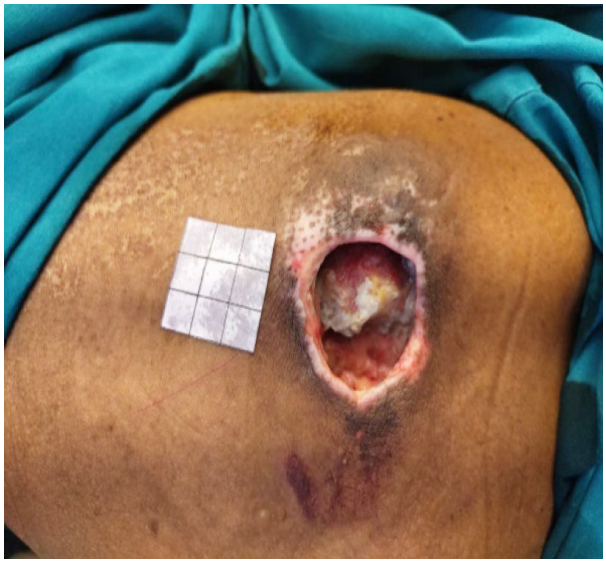

Fig. 2: Left trochanteric pressure ulcer with W.A.R. Score 6 at admission.

RESULTS

The W.A.R. score was found to be 6 which is more than 3 soappropriate antimicrobial therapy was started and hence W.A.R score could guide us in starting the antimicrobial therapy at admission.

As the antimicrobial therapy was started in time there was improvement in the wound condition (Fig. 3).

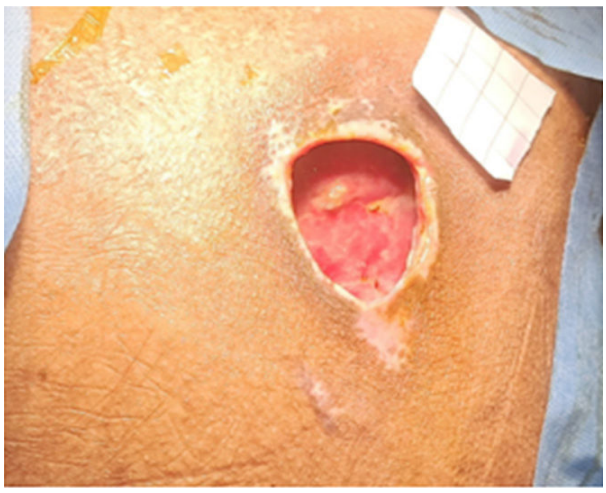

Fig. 3: Wound after initiation of antimicrobial therapy

We found W.A.R. score usefulas a wound infection prediction score at the time of admission and whether to start antimicrobial therapy or not.

DISCUSSION

The W.A.R. score emphasizes the need to consider not only the wound appearance and presentation, but the entire patient, including immune status, age, social factors, wound chronicity, and other holistic factors. Without sufficient guidelines to assist clinicians in deciding whether to start or continue antibiotics for a chronic wound, a score to help guide these decisions can help reduce both the underuse and overuse of antibiotics and potentially reduce the incidence of ADEs related to antibiotic use, including the development of MDROs at a local level. The W.A.R. score also can help to raise awareness to the fact that all wounds are contaminated, and the use of systemic antibiotics in even critically colonized wounds is not indicated in most chronic wounds. Most chronic wounds benefit from local antiseptics and aggressive wound care management.[7,9-10]

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The W.A.R. score serves as a valuable aid for clinicians in gauging infection risk and making informed decisions regarding the necessity of antimicrobial therapy.

We found W.A.R. score usefulas a wound infection prediction score at the time of admission and whether to start antimicrobial therapy or not.

The limitation of our study is that it is applied on a single case and a large randomized double blind controlled study is required to validate our study.

CONCLUSION

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Conflicts of Interest: None

Financial disclosure: None

Declarations: None

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Review Article

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Recent Advance in Transdermal Patch

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ABSTRACT

Drug administration with transdermal patches is a non-invasive technique. It is an adhesive patch that is intended to penetrate the skin and enter the bloodstream, distributing a precise dosage of medication throughout the body. Compared to other administration methods, transdermal medication delivery is less intrusive, more patient-friendly, and able to avoid first-pass metabolism and the harmful acidic environment of the stomach that arises from oral drug absorption. Transdermal patches have garnered interest and been used for many years to treat a variety of illnesses and ailments. These medications include nitroglycerin, clonidine, nicotine, and fentanyl. This approach has also been investigated recently for the delivery of biologics in several applications. Here, we examine the body of research on the design

Keywords: Transdermal patch; Types; Advance in transdermal patch.

INTRODUCTION

An additional method of administering medications through the skin layer is transdermal drug delivery.[1,2] The medication enters the bloodstream through the epidermis and travels across the body's systems before arriving at the intended location.[3,4] Compared to alternative administration methods, the transdermal medication delivery approach offers a number of advantages. Some examples are the capacity to avoid first-pass metabolism in the liver, the ability to avoid the digestive tract, and the capacity to administer continuous dosages of medications over a prolonged length of time.[5,6] Other methods of administering drugs, such intravenous, may hurt and raise the risk of infection. However, the oral route is ineffective, and it is challenging to regulate the amount when using the inhalation approach. Given its benefits over alternatives, A transdermal patch is a medicated patch that can be applied topically to provide medication at a specified rate directly into the bloodstream via the layers of skin. Actually, the most practical way to administer is via patches. They can be stopped at any time, and the course of treatment can last for several days because they are non-invasive. They have various sizes and are made up of several substances.[7,8] Through diffusion processes, the patch can introduce active substances into the systemic circulation once it is put to the skin. High

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concentrations of active ingredients that stay on the skin for a long time can be found in transdermal patches. The nitroglycerin patch was one of the earliest transdermal patches created in 1985. Gale and Berggren created the patch, which makes advantage of a rate controlling ethylene.

DESIGN OF TRANSDERMAL PATCH

A number of variables, including skin permeability, the area and length of the application, and the skin's metabolic activity (i.e., first pass metabolism), influence how well a drug travels through the skin. Actually, each medication has distinct qualities that can influence transdermal delivery. The medication needs to be non-ionic and somewhat lipophilic in order to penetrate the epidermal barrier and achieve sufficient absorption and penetration.[9,10] It is more difficult for molecules bigger than 500 Daltons to get through the stratum corneum, and the drug's therapeutic dose should preferably be less than 10 mg daily.

Components of transdermal patch

The patch's outermost layer, known as the backing layer, shields the inner layers from the elements. Typically, a flexible, waterproof substance like polyethylene or polypropylene is used to create this layer.[11,12] The purpose of the adhesive layer is to adhere and maintain the patch's position on the skin. Usually, it is composed of a skin friendly, hypoallergenic adhesive that is robust. Drugs that are absorbed through the skin are found in the drug layer. It is designed to release the medications gradually and at a steady pace. The rate at which the medications are released from the patch is managed by the rate controlling membrane. Drugs can flow through most semi-permeable membranes because they are made of such materials.

TYPES OF PATCH[13-15]

1. Drug in adhesive system
2. Drug in reservoir system
3. Drug in matrix system
4. Drug in micro reservoir system

Adhesive System Drug

The most basic type of membrane permeability control system is this one. This system's adhesive layer, which holds the many layers together, is drug-containing. The backing and liner are layered with the medication combination.

System of Reservoirs[16]

The medicine is delivered through the microporous rate controlling membrane of this device, which is sandwiched between the backing layer and the drug reservoir. Within the reservoir chamber, the medicine may be disseminated in a solid polymer matrix or exist in the forms of a gel, suspension, or solution.

Drugs in the Matrix System are evenly distributed within hydrophilic or lipophilic polymer matrices. Affixed to drug-containing discs with regulated thickness and surface area is the resultant drug containing polymer.[17]

System of Micro-Reservoirs[18,19]

This system combines a matrix dispersion system with a reservoir. In order to construct thousands of non-leaching tiny drug reservoirs, the drug is prepared here by first suspending drug solids in an aqueous solution of a water soluble liquid polymer and then uniformly dispersing the solution in a lipophilic polymer.

Micro needle

The most basic kind of microneedles are solid ones, which are made up of solid needles that pierce the skin to form microscopic channels. Solid microneedles are frequently employed in cosmetic and medication administration procedures.

Hollow Microneedles: These microneedles can transfer liquids or medications into the skin because of their hollow cores. Hollow microneedles are frequently utilized for interstitial fluid collection and transdermal medication administration.

Coated Microneedles: When a coating on these microneedles penetrates the skin, it dissolves and releases medication or other substances. Transdermal medication delivery frequently makes use of coated microneedles.[20]

Dissolving Microneedles: By using materials that dissolve in the skin, these microneedles enable the regulated release of medications or other substances. Microneedles that dissolve are frequently.

Advancement in transdermal patch

There are just two uses for conventional transdermal patches: medication release and storage.

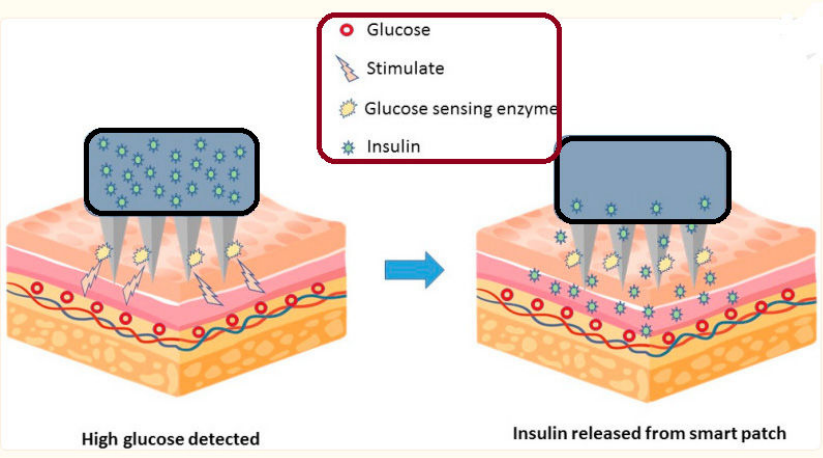
While there are several benefits to this approach, traditional patching has numerous difficulties and disadvantages, such as low release or restricted dosage. Transdermal medication delivery has seen a number of advancements to date.[21,22] Among these include the creation of innovative patches with improved drug penetration and release, increased loading, and precise drug sensing and release capabilities. All things considered, transdermal medication administration is a burgeoning field of study and research, with a plethora of fascinating new advancements to come, as will be covered below.

1. Smart patch

Sensors and other technologies are built into smart patches so that they may monitor patient circumstances and modify medicine delivery as necessary.[23] A team of scientists created a smart patch sensor platform in 2014 that uses microneedles to provide diabetics with continuous, painless intradermal glucose monitoring. This patch works by immobilizing the glucose specific c-enzyme glucose oxidase (GOx) and acting as an electrical mediator for glucose detection using a conducting polymer, such as poly (3,4-ethylenedioxythiophene) (PEDOT).

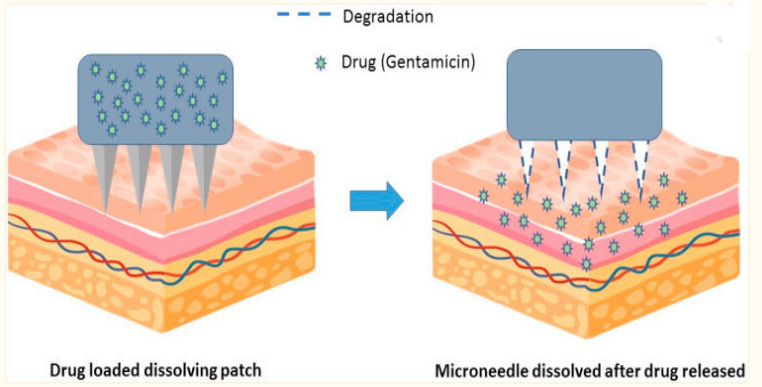
2. Degradable patch

Drugs and vaccinations that are not well absorbed by the body can be delivered with great efficiency using dissolving microneedles (MNs).[24,25] Effective transdermal insulin delivery was accomplished by localizing insulin to the needle using a two-step injection and centrifugation procedure. Insulin from MN patches had a relative pharmacological availability of 95.6% and a relative bioavailability (RBA) of 85.7%. This study shows that compared to



traditional subcutaneous injection, using dissolving patches for insulin delivery results in a satisfactory relative bioavailability (RBA), indicating the usefulness of dissolving patches for the treatment of diabetes.

An additional research team created a hypotensive biodegradable patch for transdermal delivery of sodium thiosulfate (ST) and sodium nitroprusside (SNP). Using centrifugal casting, soluble microneedles containing SNPs and STs were created.



By using this technique, SNPs were delivered onto microneedles in a stable manner and then promptly released into the bloodstream. Antihypertensive microneedle treatment (aH-MN) reduced blood pressure significantly and quickly. It satisfied the clinical standards for controlling blood pressure in cases of hypertension emergency.[26,27] Simultaneous ST treatment successfully reduced negative effects (such as organ damage) brought on by ongoing SNP consumption. An effective and patient friendly biodegradable patch for antihypertensive treatment was demonstrated in this study.

CONCLUSION

With numerous benefits over alternative administration methods, transdermal patch technology is a useful drug delivery technique. Patches can deliver continuous drug dosing for a longer amount of time by avoiding the first-pass metabolism and digestive system. They are frequently used to administer medications for a range of conditions, including hormone replacement therapy, chronic pain, and motion sickness. Transdermal patch technology has advanced significantly in recent years, with the creation of smart, biodegradable/solvent, high-loading/release, and 3D-printed patches among its numerous innovations. Although transdermal patches hold promise as a convenient and efficient drug delivery method for a range of conditions, there are a few obstacles that need to be addressed. These include the potential for self-inflicted toxicity due to incorrect dosing, poor adhesion, low drug penetration, and potential trigger for skin irritation.

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Asymmetrical Peripheral Gangrene Due to Norepinephrine Injection

Pragya Nair[1], Mauli Shah[2], Jalpa Patel[3], Dharmesh Parmar[4]

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ABSTRACT

Norepinephrine (NE) is commonly recommended as a first-line vasopressor treatment for the majority of adult patients with acute circulatory failure. Critically ill patients with circulatory shock may need rescue treatment with high doses of NE, which can be associated with a poor outcome due to excessive vasoconstriction. Herein we present a patient of post-partum hypovolemic shock who developed gangrenous changes in the digits of her hands after norepinephrine administration.

Keywords: Norepinephrine; Vasoconstriction; Gangrene.

INTRODUCTION

A 34 year old female with no known co-morbidities presented to the trauma centre with persistent vaginal bleeding following an explorative laparotomy under spinal anaesthesia after a full term normal delivery (3 kg male child) with episiotomy. On presentation the patient had hypotension (Blood Pressure-70/50 mmHg) and was given fluid resuscitation with 10 cryoprecipitate. The patient was immediately shifted to the operation theatre for emergency obstetric hysterectomy and was given 4 fresh frozen plasma, 4 Platelets, 10 cryoprecipitate and 4 packed cell volume for the 700 ml blood loss intra-operatively. The patient was shifted to the critical care centre and given intravenously noradrenaline 2 amp in 50cc of normal saline at 4ml/ hour infusion rate for 4 days.

After 3 days, the patient developed painful reddish lesions over both hands. The patient also complained of blackening of left hand ring finger and fluid filled lesions over both hands and feet. On examination gangrenous changes of size approximately 2 x 3 cm over left hand ring finger were noted. (Fig. 1 & b) Erythematous, tender, inflamed plaques of size approximately 1 x 2 cm in size over right hand (Fig. 2) and few erythematous macules and bullae over both dorsum of feet was present. (Fig. 3) The patient did not have history of any topical application before appearance of lesions or any food or drug allergy. No similar complaints in the past were noted. The patient had a Full term normal delivery of a 2.5 kg male child 11 years ago but did not have any blood transfusions or similar

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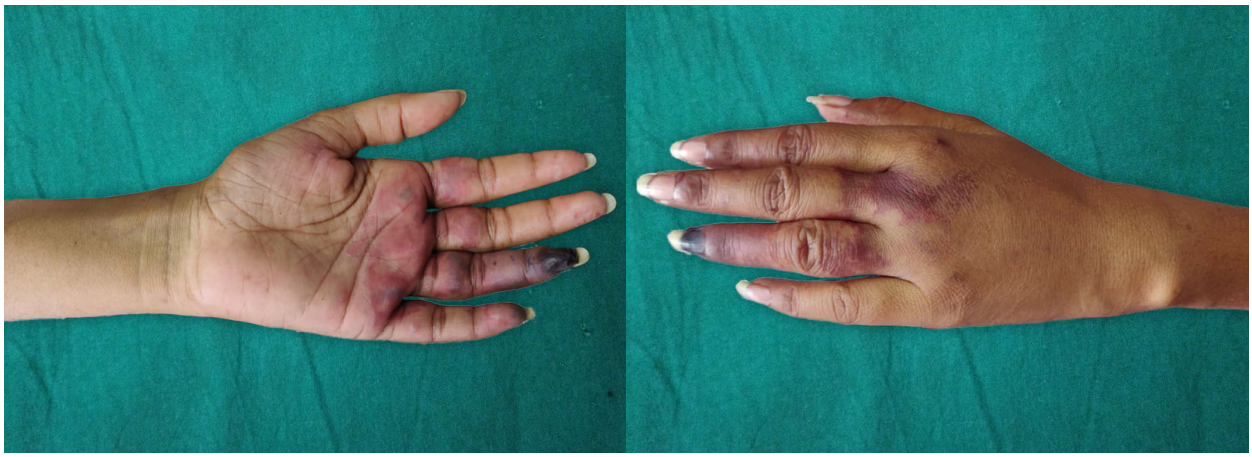

Fig. 1: Gangrenous changes of size approximately 2 x 3 cm over left hand ring finger

a) Palmar aspect **b)** Dorsal aspect

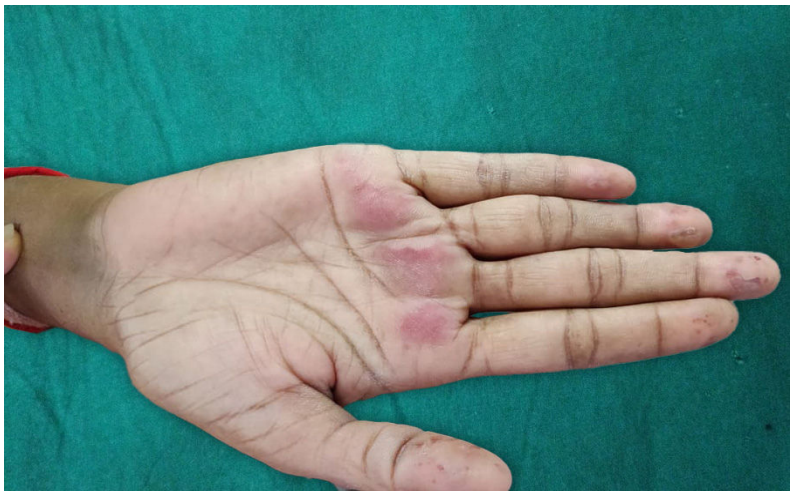

Fig. 2: Erythematous, tender, inflamed plaques of size approximately 1 x 2 cm in size over right hand.

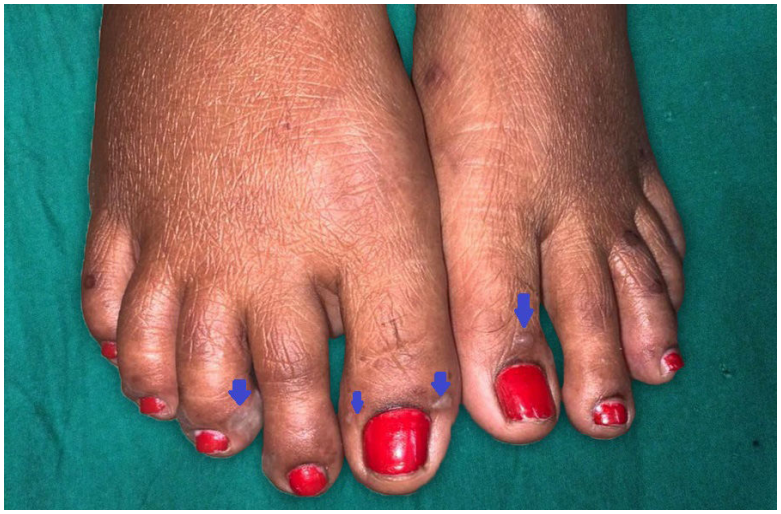

Fig. 3: Few erythematous macules and bullae over both dorsum of feet

episodes during that delivery. No history of hair loss or Raynaud's phenomenon was elicited. The patient was started on Inj Enoxaparin 0.4 ml SC once daily for 7 days followed by tab Apixaban 5 mg twice a day, tab Aspirin 75 mg once daily and local application of silver sulphadiazine and zinc sulphate cream twice a day. She gradually showed improvement in the form of resolution of blisters which was replaced by gangrenous changes over left ring and little finger. (Fig. 4a & b)

DISCUSSION

Intravenous norepinephrine (NE), an alpha-receptor stimulator, with vasoconstrictor properties, is used in patients with septic shock and hypotensive states, but on occasion it may produce extreme local vasoconstriction resulting in necrosis of tissues.[1] It also has some β1 receptor agonist activity that results in a positive inotropic effect on the heart at higher doses.[2]

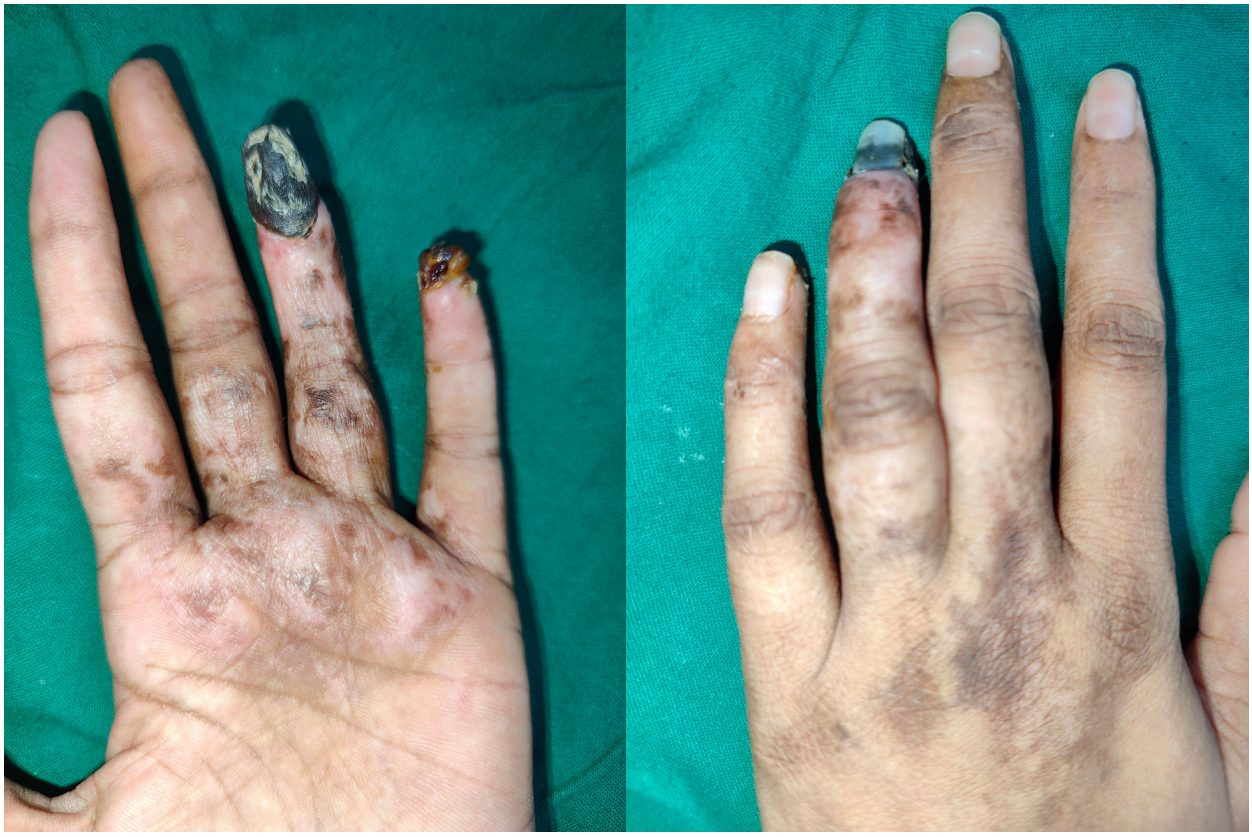

Fig. 4: Gangrenous changes over left ring and little finger after treatment

a) Palmar aspect **b)** Dorsal aspect

The precise pathophysiology of vascular occlusion remains unclear. Low-flow state is commonly associated with hypercoagulable vasospastic condition, leading to microcirculatory occlusion. The pathogenesis of symmetrical peripheral gangrene may involve bacterial endotoxin release and platelet plugging in peripheral arterioles due to vascular collapse and disseminated intravascular coagulation.[1]

Our patient lacked risk factors for peripheral vascular disease and diabetes mellitus. Treatment with inotropes was not prolonged or in high doses, so it can be suggested an idiosyncratic response.

Digital necrosis caused by NE tends to be bilateral and symmetrical and usually affects a patient's toes.[3,4] However, as seen in our case, asymmetrical presentation and finger gangrene is been described which is uncommon. It is believed that the necrosis of tissue is due to intense prolonged arteriolar vasoconstriction produced by high local concentration of noradrenaline.[5] The development of gangrene was subsequent to Inj Noradrenaline at the infusion rate of 4 ml/hour for 4 days in our case with asymmetrical involvement.

Since the vasospastic effects of NE may be more intense in the digital vascular beds, low blood pressure could certainly have contributed to her digital gangrene.

The three stages leading up to symmetrical peripheral gangrene are sepsis, ischaemia and gangrene. Treatment can be administered at each stage to prevent, slow or reverse the course.

The therapies that slow or reverse ischaemia are sympathetic blockers, intravenous vasodilators, local injection of alpha-blockers, intravenous alpha-adrenergic antagonists such as chlorpromazine hydrochloride and infiltration of the ischaemic areas with phentolamine hydrochloride and phosphodiesterase inhibitors.[3] Locally nitroglycerine ointment and epoprostenol have been reported as beneficial.

Inj Enoxaparin a low molecular weight heparin binds to and potentiates antithrombin 3 to form a complex that irreversibly inactivates factor Xa inhibiting thrombus formation. Apixaban inhibits free and clot bound factor Xa and prothrombinase activity, thus decreases thrombin generation and thrombus formation. Aspirin impairs platelet aggregation via inhibition of platelet thromboxane A2 synthesis thus reducing thrombus formation.[6]

The only definitive treatment for gangrene is amputation of the necrotic digits after development of a clear line of demarcation. Autoamputation of the gangrenous digits may also occur .Local wound care consist of interdigital padding to protect the gangrenous or ischaemic extremities, antiseptic dressings, debridement and antibiotics.

Microvascular spasm is a rare complication of inotrope use which must be considered especially in patients with pre-existing peripheral vascular disease.

CONCLUSION

We report this rare case of asymmetrical peripheral gangrene following prolonged ionotrope administration. Microvascular spasm is a rare complication of inotrope use which must be considered especially in patients with pre-existing peripheral vascular disease.

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