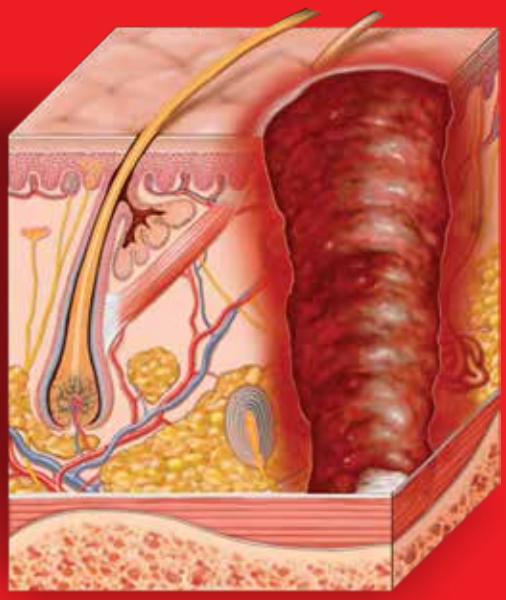

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Prevention and Treatment of Pressure Ulcer – A Serious Complication of Multimorbidity and Immobility

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ABSTRACT

Pressure ulcers (PU) are a serious complication of immobility as well as multimorbidity, with global prevalence rates ranging from 8.8% to 53.2%. PUs are usually difficult to manage and have a negative impact on the patient's quality of life; however, PUs are often preventable. This article provides an overview of PUs, their epidemiology, clinical pattern, risk factors, mechanism of action and management. The article also focuses on the role of silicone-based dressings in the management of PU.

Keywords: Pressure ulcers, risk factors, prevention, management, silicone dressings

Pressure ulcers (PU), a serious complication of immobility as well as multimorbidity, is a wound which begins in the upper layers of the skin due to sustained pressure, or pressure combined with shear, and then extends into the deeper tissue layers.[1,2] PU or bed sores occur when patients cannot reposition themselves to relieve pressure on bony prominences. PUs are usually difficult to manage, painful and costly. PUs have negative impact on the patient's quality of life but are often preventable.

EPIDEMIOLOGY

Globally, prevalence rates of PU range from 8.8% to 53.2% and incidence rates vary from 7% to 72.5%.[1-3] However, there are large variations observed between clinical settings - acute care, aged care and community care (Table 1).[3]

Prevalence and incidence rates are higher in special high-risk populations, such patients in palliative care, or with spinal cord injuries, neonates and infants and people in critical care. PUs occur in up to 23% of patients in long-term and rehabilitation facilities.[4]

Table 1. Rate of PU Prevalence and Incidence Under Different Care Settings

Population	Prevalence (%)	Incidence (%)
Acute care	0-46	0-12
Critical care	13.1-45.5	3.3-53.4
Geriatric care	4.1-32.2	1.9-59
Pediatric care	0.47-72.5	0.27-27
Operating room	-	5-53.4

Prevalence is about 30% in geriatric settings and about 20% in nursing-dependent patients in home care.[2] The incidence of PUs in intensive care unit (ICU) setting is 10-41%.[4]

In India, there are very few systematic studies of PU. Chauhan et al reported PU prevalence of 4.94% in 445 hospitalized in medical and surgical wards.[5] Mehta et al reported prevalence of 7.8% in all hospitalized patients.[6] Prevalence in intensive care was 24.3%. Sacrum and heels were most commonly affected. Most common ulcers were Grade III - 42.8%.[6]

CLINICAL PATTERN

PUs are graded, based on extent and depth of involvement, as per National Pressure Ulcer Advisory Panel (NPUAP)-European Pressure Ulcer Advisory Panel (EPUAP) International classification system (Table 2).[2]

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Common sites for PUs are:

- Patients lying on back – sacrum, coccyx, spinous processes, heels, ankles and elbows
- Patients lying on side – iliac crest, trochanters, helix of the ear.

Most common PU sites are the sacrum and the heels, and majority of PUs are stage I or stage II in severity.[1]

Pain and discomfort are most important problems. PUs have a profound impact on emotional, physical, mental and social domains of life.[1] PUs pose a major burden of illness and reduced quality of life for patients and their caregivers.[3] In USA, the development of a single PU in hospital can increase the patient's length of hospital stay fivefold.[3]

PUs are associated with increased mortality. Amongst patients with PU, there is a twofold increase in death compared to those who do not have pressure ulcers.[1] In US, >60,000 patients die each year as a direct result of PUs.[4]

RISK FACTORS

PUs occur when risk factors which prevent repositioning to relieve pressure on bony prominences. The risks could be: 1) Intrinsic - patient-related or 2) Extrinsic - related to the patient's environment (Table 3).[2,6]

Table 2. NPUAP-EUPAP International Classification System for Pressure Ulcer

Category/ Stage	Title	Description
I	Nonblanchable redness of intact skin	• Intact skin with nonblanchable erythema of a localized area usually over a bony prominence. • Discoloration of the skin, warmth, edema, hardness or pain may also be present. • Darkly pigmented skin may not have visible blanching. • The area may be painful, firm, soft, warmer or cooler than adjacent tissue. • May be difficult to detect in individuals with dark skin tones. • May indicate 'at risk' persons.
II	Partial thickness skin loss or blister	• Partial thickness loss of dermis that presents as a shallow open ulcer with a red pink wound bed, without slough. • May also present as an intact or open/ruptured serum filled or serosanguinous filled blister. • Presents as a shiny or dry shallow ulcer without slough or bruising.
III	Full thickness skin loss (fat visible)	• Full thickness tissue loss. • Subcutaneous fat may be visible, but bone, tendon or muscle are not exposed. • Some slough may be present. • May include undermining and tunneling. • Depth varies by anatomical location. ▸ Bridge of the nose, ear, occiput and malleolus do not have (adipose) subcutaneous tissue; ulcers can be shallow. ▸ Areas of significant adiposity can develop extremely deep pressure ulcers. • Bone/tendon is not visible or directly palpable.
IV	Full thickness tissue loss (muscle/bone visible)	• Full thickness tissue loss with exposed bone, tendon or muscle. • Slough or eschar may be seen. • Often include undermining and tunneling. • Depth varies by anatomical location. ▸ Bridge of the nose, ear, occiput and malleolus do not have subcutaneous tissue; ulcers can be shallow. • Can extend into muscle or supporting structures (such as fascia, tendon, joint capsule) causing osteomyelitis or osteitis likely to occur. • Exposed bone/muscle is visible or directly palpable.

Table 3. Risk Factors Contributing to Development of Pressure Ulcers

Intrinsic - Patient-related	Extrinsic - Related to the patient's environment

• Elderly
• Critical care
  ▸ ICU
  ▸ Acute illness
  ▸ Mechanical ventilation
• In long-term homes/home care
• Trauma
  ▸ Spinal-cord injuries
  ▸ Fracture hip
• Neurological disease
  ▸ Impaired consciousness
  ▸ Impaired perception
  ▸ Motor disturbances
  ▸ Sensory disturbance
  ▸ Diminished pain perception
• Cardiovascular diseases
  ▸ Peripheral arterial occlusive disease
  ▸ Congestive heart failure
• Nutritional problems
  ▸ Anemia
  ▸ Cachexia
  ▸ Malnutrition
  ▸ Inadequate fluid replacement
• Diabetes mellitus
	• Undue and prolonged pressure
	• Friction
	• Shear
	• Moisture
	• Abnormal posture
	• Impaired mobility

MECHANISMS OF PU FORMATION

PU occurs because of complex interplay of:[1-3]

- Pressure – develops on bony prominences, as immobile patients cannot reposition themselves.
- Friction – can disturb the barrier function of the stratum corneum and is an additional risk for infection to occur concurrently with PUs.
- Shearing – is the mechanical stress seen when a patient is sliding down the bed, but his skin remains in the same place since it sticks to the bed linen.
- Moisture – causes softening of the upper layers of the skin and makes skin vulnerable to dermal erosion and increased risk of pressure ulceration.

In patients at high risk of PU formation, there is a lower threshold for occlusion of blood vessels causing ischemia-induced damage and a higher threshold for direct deformation-induced damage.[3] When a patient is exposed to sustained external mechanical forces – prolonged pressure, friction and shear forces – there is local ischemia, reperfusion injury to cells, impairment of interstitial fluid flow and lymphatic drainage, and prolonged deformation of cells.

Friction can result in PU indirectly and directly.[7] In the indirect sense, friction is essential to create the shearing forces. When skin is damaged by pressure ischemia, it may become more susceptible to friction. Friction and pressure ischemia will work together to accelerate breakdown of skin. Prolonged pressure, friction and shear forces, alone or combined, lead to reduction in the oxygen and nutrient supply to cells, impairment of the removal of waste products following cell metabolism, causing cell damage and inevitable tissue destruction.

MANAGEMENT OF PU

- Evaluate risk factors[3] – Utilize a well-defined approach to risk assessment which includes assessment of activity/mobility and skin status – category/stage of PU.
- Assess impact of perfusion and oxygenation, e.g., blood pressure, diabetes, edema, smoking.
- Consider impact of poor nutritional status.
- Evaluate impact of increase in skin moisture, e.g., urinary incontinence, fecal incontinence, urinary catheter *in situ*.
- Review potential impact of increased body temperature, advanced age, sensory perception, abnormal hematology and general health status.

Use of scales, e.g., Braden, Norton, Waterlow, can support clinical judgment in systematic assessment of risk factors.

Treatment of PU

Treatment of existing PU requires consideration of:[3]

- Effective assessment of ulcer
- Monitoring of healing by measuring ulcer area
- Management of pain
- Wound management – cleansing, debridement, infection, dressings and surgery.

Prevention of PU

Preventive measures require attention to all risk factors – nutritional care, repositioning and skin care.

Nutritional care

Malnutrition is linked to the risk of developing PUs, PU severity and impaired healing of wounds.[3] Hence, all patients at high-risk of developing PU should be screened for any nutritional deficiencies. A dietitian should carry out detailed and comprehensive nutrition assessment, focusing on: 1) weight status, 2) patient's ability to eat and 3) adequacy of total nutrient intake. The dietitian should consult other medical and paramedical experts, and develop an individualized nutrition intervention plan considering caloric, protein, vitamin and mineral requirements and hydration. The nutrition plan should be monitored regularly.

Repositioning and early mobilization

Repositioning and mobilization of patients is a vital part of prophylactic management of PU.[3] Regular repositioning helps to reduce the duration and amount of pressure over vulnerable parts of the body and to provide comfort, improve hygiene, maintain dignity and functional ability. If regular repositioning is not possible, an alternative prevention strategy using a high specification mattress or bed may be useful. Positioning the patient on bony prominences should be avoided if there is nonblanchable erythema at the site. As sacrum and heels are common sites of PU, special attention should be given to the sites while repositioning the patient. The heels can be kept free of the surface of the bed by using suspension devices that elevate and relieve pressure on the heel completely.

Support surfaces

These are specialized devices, e.g., special mattresses, for pressure redistribution with characteristics of immersion, envelopment and heat and moisture permeability. Support surfaces are an important component of PU treatment as they provide an environment that improves perfusion of injured tissue. Selection of support surfaces should be individualized considering several factors, e.g., level of immobility and inactivity, need for microclimate (temperature and humidity of the interface between the support surface and the patient) control and shear reduction, and risk of developing new PU.[3]

Skin care

Maintaining skin integrity is vital in the prevention of PU.[3] Maintaining healthy skin requires detailed assessment and planning of care.

Preventive skin care includes:

- Avoid positioning the patient on an area of erythema whenever possible.
- Maintain cleanliness and dryness of skin by using pH balanced skin cleanser, e.g., emollient, deodorant and water-repellent barrier.
- Avoid massaging or vigorously rubbing the skin which is at risk of PU.
- Implement a plan to manage continence problems. Skin should be cleansed immediately after any episode of incontinence.
- Use a barrier product, e.g., silicone gel, which provides protection to the skin from exposure to excessive moisture and helps in reduction of friction and pressure damage.

Prophylactic dressings/Topical applications

Prophylactic topical applications have a role in reducing friction and decreasing localized shear forces.[3] Prophylactic ability of such topical applications depends on: 1) type of dressing - elastic adhesive silicone, 2) the number of layers and their construction and 3) the size of the selected dressing.

Mechanism of Action of Barrier Application

Prophylactic topical application/dressing of silicone-based therapies work in multiple ways to help in prevention of PU. One such silicone-based protectant and soothing translucent gel contains several active components, with diverse attributes.[8]

- Cyclopentasiloxane, the most commonly used silicone in the cosmetic industry, has high volatility and mild solvent properties, thus making it ideal to be used in topical formulations. Its low heat of vaporization suggests that it has a 'dry feel' when applied to the skin.
- Dimethicone is antifoaming agent, emollient, and water repelling agent.
- Dimethicone polymer is a viscosity increasing and dispersing agent.
- Magnesium Aluminum Metasilicate is lubricant, emulsifier and coating agent.
- Silica silylate is a hydrophobic white, fluffy powder, which has a very high sebum/oil absorption capacity.

These components of the gel impart special properties relevant to prevention of PU. These are:

- Adhesiveness – smooth adhesive film which sticks to the skin, forming an invisible, dry, silky-smooth, protective, anti-friction barrier, preventing heat and skin tear due to friction.
- Abrasion resistance – ability to be retained on the skin when exposed to forced abrasion.

- Resistance to friction – lowering of friction on the skin surface helps to reduce the friction on the skin.
- Moisture – a nonocclusive barrier which is comfortable to the user as it allows skin to breathe and sweat to escape.

These ingredients are used regularly as cosmetic ingredients in most of the personal care products and are listed as safe in literature.

Within seconds of application, the gel dries to form a long-lasting, flexible, water-repellent and protective anti-friction film. The film reduces friction by 80% between skin and clothing/bedding, thereby helping prevent PUs. It protects skin exposed to irritation from moisture such as sweat, urine or fecal matter. This barrier film is breathable that provides comfort to the patient without hampering regular function of skin.

CLINICAL TRIALS: SILICONE APPLICATION

Clinical trials of prophylactic topical applications face many challenges:

- Recruitment of patients to achieve homogeneity in acute care settings where patients have diverse medical conditions.
- Difficulty of deciding statistically relevant sample size due to nonavailability of data on background incidence of PU at Indian hospitals.
- Difficulty of blinding/masking the topical application and ensuring randomization.
- Need to standardize other factors, e.g., nutrition, repositioning, beds, bed sheets.
- Training of nursing/other staff in consistency in use of scales for assessing wounds for frequent observations of bed sore at multiple sites.
- Difficulty of detecting early redness in dark skin.
- Ethical consideration – As efficacy of silicone-based topical applications in prevention of PU is well-established with all studies favoring use of such dressing/applications,[3] it would be unethical and risky to deprive the patient the benefits of preventive topical application.

Several clinical trials have shown reduction in occurrence of PU at high-risk anatomical locations – heels, sacrum - when a prophylactic polyurethane foam soft silicone dressing was applied (Table 4).[1,9-13]

In view of such evidence of preventive effect of silicone-based foam dressing, all patients at risk of developing PU should be offered application of polyurethane foam dressing – silicone - to bony prominences (e.g., heels, sacrum) for the prevention of PU in locations frequently subjected to friction and shear.

Table 4. Clinical Trials of Silicon-based Preventive Therapy for Pressure Ulcer

Study	Control incidence (%)	Silicone dressing incidence (%)
Kalowes et al[9]	5.9	0.7
Park[10]	46	6
Santamaria et al[11]	17.8	4.3
Brindle and Wegelin[12]	11.4	2
Chaiken[13]	13.6	1.8

CONCLUSIONS

Pressure ulcers are a serious complication of immobility and are associated with high morbidity. All efforts should be made to prevent PUs in high-risk patients combining nutritional care, repositioning and skin care and prophylactic application of silicone-based topical applications.

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