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Skin Failure: An Emerging Concept

Jeffrey M. Levine MD, AGSF, CMD, CWSP *

Center for Advanced Wound Care, Beth Israel Medical Center and Icahn School of Medicine at Mount Sinai, New York, NY

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A B S T R A C T

Skin failure is an emerging concept that clarifies trends in clinical practice. Its recognition provides common nomenclature, opens research directions, and questions assumptions regarding pressure ulcers as a quality measure. Adoption of the term is a step toward uniform terminology in compliance with a value based payment system.

Skin failure is an emerging concept that ties together and clarifies current trends in clinical practice. Many studies have associated acute and chronic skin ulceration with mortality, yet the term skin failure has not been adapted to this phenomenon.[1–3] Wound care providers have long recognized that skin failure exists, but common use of the term has been limited due to confusion as to its clinical manifestations. Terms such as Kennedy Terminal Ulcer (KTU), skin changes at life's end (SCALE), and the Trombley-Brennan Terminal Tissue Injury (TB-TTI) lesion have been advocated to describe the common clinical observation of skin breakdown in patients who are dying.[4–6] However this nomenclature does not fit into the clinical course of wounds that have similar characteristics but the patient does not expire. The term skin failure assembles these clinical observations into an easily understandable and more clinically accurate term.

Pressure ulcers are a major concern in post-acute and long-term care settings.[7–9] Reported incidence of pressure ulcers in long-term care varies widely in the literature, ranging from 3.6% to 59.0%.[10] The incidence in terminally ill nursing home residents is reported as high as 54.7%.[11] Pressure ulcers are also a major target for litigation in negligence claims against nursing homes, second only to falls.[12] According to the Agency for Healthcare Research and Quality there are more than 17,000 lawsuits related to pressure ulcers annually.[13]

There is ample evidence to support the argument that improvements in nursing care relevant to skin care/pressure ulcer prevention or management have contributed to better skin outcomes in both hospital and long-term care settings.[14,15] Evidence-based advances include risk-assessment tools and improved preventive interventions and technologies.[7] Nonetheless, there is growing recognition that pressure ulcers can occur even when risk is recognized and preventive interventions are implemented.[16]

We now have improvements in life-support technologies in intensive care, hospital, and rehabilitation settings applied to an increasingly high-risk population that effectively prolongs life, therefore negating terminology that implies mortality. Pressure ulcer development is a significant predictor of mortality, and is associated with failure of multiple organ systems.[17] Nonetheless, many patients who develop pressure ulceration in the face of acute or chronic illness do not die and may go on to heal. This article proposes clarification of nomenclature through recognition of skin failure as a clinical syndrome that shares similar mechanisms with other organs. This will encourage a broader conceptual framework acknowledging that some pressure ulcers, whether or not associated with mortality, are unavoidable consequences of skin failure. Unification of terminology that acknowledges skin failure accounting for unavoidable pressure ulceration is necessary in the era of value-based health care.

What is Skin Failure?

Langemo and Brown[18] defined skin failure as an event whereby skin and underlying tissues die due to hypoperfusion that occurs concurrent with dysfunction or failure of other organ systems, but this is not the only definition. Clinical manifestations of skin failure vary widely in the medical literature (see Table 1). Some authors describe skin failure from dermatologic conditions, such as erythroderma, toxic epidermal necrolysis, Stevens-Johnson syndrome, or scalded skin syndrome, without considering pressure ulceration.[19,20] Other authors recognize skin failure but state that it is a separate entity from pressure ulceration.[21,23] Still others classify pressure ulcers directly under the category of multiple-organ failure that accompanies the terminal stages of disease processes and advanced age.[22] This confusion in

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* Address correspondence to Jeffrey M. Levine, MD, AGSF, CMD, CWSP, 928 Broadway, Ste. 709, New York, NY 10010.
E-mail address: jlevinemd@shcny.com.

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Table 1
Clinical Manifestations of Skin Failure as Described in the Literature

Clinical Features	References
Skin failure includes dermatologic conditions such as Stevens-Johnson Syndrome; no mention of pressure ulcers.	Irvine[19] (1991), Inamadar and Palit[20] (2005)
Skin failure is a separate entity from pressure ulcers.	White-Chu and Langemo[21] (2012)
Pressure ulcers are a manifestation of skin failure in the setting of multiple organ system failure.	Witkowski and Parish[22] (2000)

taxonomy has resulted in limited clinical usefulness and unclear practical application of the term. To enhance the practical application of this definition, there must be clarification of its physiologic, pathologic, and molecular mechanisms and guidance as to clinical manifestations at the bedside. The definition of skin failure must include diagnostic criteria that relate to specific functions of skin, analogous to criteria for failure of any other organ system.

When defining clinical criteria for skin failure, a logical place to start is the normal function of skin. If skin no longer performs its role maintaining vasomotor tone, body temperature, and water balance, and ceases protecting the body from infection and mechanical trauma, it can be considered to be failing. In this model, the KTU, SCALE, and TB-TTI are manifestations of skin failure because the organ can no longer provide protection from external insults, allowing entry of bacteria. Skin failure can account for the high rate of breakdown in the setting of multiorgan system failure, and unavoidable pressure injury when preventive interventions have been implemented. By folding these observations into the spectrum of skin failure, quality deficit implications are removed and the terminology becomes more accurate and uniform.

Case Examples

Case 1

A 68-year-old man with type 2 diabetes mellitus and history of smoking 2 packs per day presented to the emergency room (ER) with 3 months of cough, poor appetite, 15-pound weight loss, dyspnea, and weakness. Past history included prostate cancer treated with radical prostatectomy and external beam radiation. His oxygen saturation was in the 70s and he was intubated and admitted to the critical care unit, where workup revealed nonresectable squamous cell lung cancer metastatic to mediastinum and liver. Other physiologic parameters included serum albumin of 2.1. In the intensive care unit (ICU) his Braden Score was 14 and preventive measures were implemented including offloading and pressure redistribution surfaces. He was extubated after 8 days and elected to undergo chemotherapy, but suffered worsened anemia and pancytopenia, and his appetite remained poor. After 2 weeks in the hospital he developed a purple area on his left buttock that was determined to be a deep tissue injury (DTI). He was transferred to a post-acute care facility where the DTI evolved into an eschar that required sharp debridement. The patient died on hospice 4 months after initial presentation.

Case 2

A morbidly obese 55-year-old man on long-term prednisone for chronic obstructive pulmonary disease presented to the ER hypotensive with colon perforation and septic peritonitis. He underwent emergency exploratory laparotomy with partial bowel resection, and was admitted to the ICU where he remained hypotensive in septic shock on pressor agents and intravenous antibiotics. His Braden Score was 10 and preventive measures were implemented, including offloading and pressure redistribution surfaces. On the 10th hospital day, he was noted to have DTI to the sacral area that progressed to eschar. He was discharged to a post-acute care rehabilitation setting after 1 month in the hospital, but had a stage 4 pressure ulcer that required months of inpatient and outpatient wound care, including sharp debridements and negative-pressure wound therapy.

Case 3

An 87-year-old woman suffered from Alzheimer dementia for 8 years, lost her ability to eat, and suffered an 18-pound weight loss. Her health care proxy “wanted everything done” and a percutaneous gastrostomy was inserted. She lived in a nursing home and was hospitalized several times for recurrent urinary tract infections and aspiration pneumonia. Her Braden Score remained in the 8 to 12 range, and she remained on a turning regimen and pressure redistribution surface. After 2 years on a feeding tube she developed skin breakdown to the sacrum and left hip that progressed to eschar, and died 3 weeks later.

The Historical Context of Skin Failure

Historical factors in the medical industry have created barriers that inhibit a unified, interdisciplinary approach to skin failure. In 1859, Florence Nightingale declared in her seminal book, *Notes on Nursing*, that pressure ulcers were the result of inadequate nursing.[24] This view is outdated, but remains part of our health care culture, and nurses are largely responsible for pressure ulcer prevention and basic skin care. Treatment of advanced pressure ulceration is not commonly addressed by internal medicine physicians except for infected wounds, and their care is generally delegated to surgeons or surgical subspecialties. Dermatology branched off into its own specialty, separate and apart from internal medicine in the 20th century, and with some exceptions remains primarily an outpatient practice. Many medical doctors today have had little training in the basics of wound care and pressure ulcer staging.[25] These combined factors create barriers whereby skin is often not considered in the problem list of the internist or primary care physician, and omitted from the practitioner’s list of concerns. Although this omission appears illogical, it is reinforced by the medical profession’s history, education, and culture.

In the 19th century, the great neurophysiologist Jean Martin Charcot recognized that a specific type of pressure ulcer heralds impending death, and he named this entity the *decubitus ominosus*.[26] Charcot’s nomenclature was subsequently forgotten, but the concept that pressure ulcers precede death was revived in the late 20th century with the KTU.[4] The KTU provides succinct description of a phenomenon that nearly everyone in the wound care field has observed at the bedside, and is commonly used despite lack of universal acceptance and limited research validation.[27] A similar lesion, the TB-TTI, was described in 2012.[6] A major challenge for these eponymous syndromes is lack of a soundly proven pathophysiological framework and the observation that some patients with similar wounds do not die.

In an effort to improve the scientific framework of the KTU, a panel of experts expanded on the concept of skin changes at life’s end, naming it SCALE.[5] However, neither KTU nor SCALE nomenclature accounts for patients whose physical decline approaches death but where death does not occur. When patients develop pressure-related injury when critically ill or dying, and medical interventions and life-support technologies result in clinical improvement or maintenance of a state of chronic critical illness, accuracy of the terms KTU, SCALE, and TB-TTI is compromised. Nonetheless, similar mechanisms apply, and nomenclature accounting for the entire spectrum of clinical observations is essential. This revised paradigm is best framed in the

context of skin failure that incorporates *decubitus ominosus*, KTU, SCALE, and TB-TTI as well as pressure injuries that occur in patients who are critically ill but survive.

Skin Failure Is Understudied

Skin is a complex multifunctional organ whose existence is intimately dependent on the health of other organs to maintain oxygenation, perfusion, and delivery of nutrients; however, there is a large gap in our knowledge regarding skin failure. For example, skin failure has not been studied as part of the multiorgan dysfunction syndrome (MODS). MODS is a defined entity that occurs in up to 14% of all patients admitted to ICUs, and the syndrome is responsible for as many as 80% of all ICU deaths.[28] MODS, also known as multiple-organ failure, is associated with sepsis syndrome, systemic inflammatory response syndrome (SIRS), and the recently described persistent inflammation, immunosuppression, and catabolism syndrome.[29] Several tools have been developed to quantify MODS to measure clinical outcomes and disease severity, and predict mortality.[30–33] These measurement systems take into account respiratory, cardiovascular, hepatic, renal, coagulation, and central nervous systems, but none incorporate skin.

Skin failure has not been included in studies of the recovery period after MODS. A recent review of 1173 articles studying persistent or long-term organ dysfunction after severe sepsis did not include observations on skin.[34] It is surprising to consider that the study of organ failure and its sequelae has not included the largest organ of the body, even though skin failure in the form of pressure ulcers is a well established marker of illness severity and death.[35] This is because there are no readily available, universally agreed on biochemical markers with which to measure or quantify skin failure as are available for other organ systems.

Skin Failure and Quality Measurement

Our new value-based payment system mandated by the Affordable Care Act provides financial disincentives for adverse outcomes that reflect quality deficits, and caregivers should not be penalized for something that cannot be prevented. Experts point out the need to determine quality measures for wound care that appropriately reflect the quality of care provided.[36] The concept of skin failure calls into question basic assumptions regarding the validity of pressure ulcers as a quality measure. Pressure ulcers have long been associated with quality measurement and the perception of quality in long-term care.[37] Hospitals became involved with pressure ulcers as a quality measure when the Centers for Medicare and Medicaid Services introduced the Hospital Acquired Conditions list in 2008 that included stage 3 and 4 wounds.[38] Practitioners have often voiced concern that pressure ulcers may not reflect quality deficit, particularly with increased recognition that many are unavoidable.[22,39]

Skin failure fits neatly into the emerging concept of unavoidable pressure ulceration. Evidence shows that unavoidable wounds occur frequently in the setting of multiorgan system disease.[40,41] Edsberg et al[16] pointed out the lack of literature focused on pressure ulcer avoidability and the close association of multiple-organ failure with pressure ulceration. This review underscored the importance of nonmodifiable risk factors in the genesis of unavoidable pressure ulcers. It is natural to conclude that once skin can no longer survive intact in the setting of severe physiologic and mechanical stress (ie, nonmodifiable intrinsic and extrinsic risk factors) that it has undergone failure.

If a pressure ulcer is an unavoidable result of multiorgan system dysfunction, sepsis, SIRS, or end-of-life conditions, it is incorrect to attribute this outcome to poor care when providers have implemented appropriate preventive interventions. Doing so mars the reputations of facilities and practitioners, negatively impacts reimbursement, and results in a risk-management problem.[42] Charcot believed, although incorrectly, that all pressure ulcers were unavoidable consequences of disruption of nerve fibers.[43] More than a century later, the study of pressure ulcer avoidability is still in its infancy, but preliminary data from the Office of Inspector General (OIG) shows that as many as 40% of these wounds are unavoidable.[35] The OIG report used a stepwise review with a structured algorithm to make their determination, and pressure ulcers were one of many clinical outcomes studied.

Once the terminology is unified, it would be appropriate to add skin failure as an ICD-10 coded diagnosis that can be used by clinicians. Caution, however, needs to be exercised for potential misuse or overuse of the term to reduce liability.[44] Adoption of the term *skin failure* will be a positive step toward developing uniform terminology in compliance with the Health Information Technology for Economic and Clinical Health (HITECH) Act and Meaningful Use required by the Health Care Reform Act.[45] HITECH mandates interoperable electronic health records throughout the health care continuum as a critical national goal. A common clinical vocabulary will increase the accuracy of quality indicators and add value to our service as wound care providers.[46] Revised coding and terminology will not only accommodate accurate quality measures, but common definitions will facilitate the analytical challenges of clinical research as recommended in a recent review of wound repair and healing in older adults.[47]

The Future

Skin failure must be recognized as a clinical syndrome, as it ties together observations that clinicians frequently encounter at the bedside. One may criticize the term, as it infers a dichotomous event that is either present or absent rather than a continuum of physiologic derangements. Skin, however, is a multifunctional organ that manifests a number of changes with age and comorbid illnesses.[48] The alternate term “skin dysfunction” may be too vague to capture the essential elements required at the bedside. In addition, when using the term “failure” in conjunction with other organ systems, an all-or-nothing phenomenon is not inferred, but rather a continuum is described and measured in accordance with parameters specific to the organ.

Experts have pointed out the scarcity of evidence in the area of pressure ulcers.[49] Once skin failure is recognized as a legitimate diagnosis, the research agenda becomes clearer. Skin needs to be incorporated into the definition of MODS, and measurement scales adjusted accordingly. Mechanisms in common with other organs require exploration, such as immunosuppression and inflammation associated with critical illness, endothelial dysfunction, and vascular hyperpermeability.[29,50] Other promising research directions include dysregulation of oxygen homeostasis with increased production of reactive oxygen species, failure of the antioxidant systems, and mitochondrial failure.[34] Questions should target identification of biomarkers for skin failure, phenotypes of persons at risk, and mechanisms that promote its occurrence with an eye toward developing interventions for prevention and treatment.

The recognition of skin failure as a clinical syndrome will lay the foundation for common nomenclature and open new directions for research. In addition, we now have a golden opportunity to collaborate in interdisciplinary research, recognizing and building on contributions made by the nursing profession in skin care. From a clinical perspective, this terminology builds on the *decubitus ominosus*, KTU, SCALE, and TB-TTI for more accurate classification of an identified disease state that will facilitate data collection for research and improved quality measurement. In an era of data-driven, outcomes-oriented, and value-based care, it is time to collaborate with our colleagues and create a multidisciplinary, unified approach to skin

failure: a phenomenon that occurs in the course of acute and chronic illness as well as in patients who are at the end of life.

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