SKIN FAILURE

What we should know

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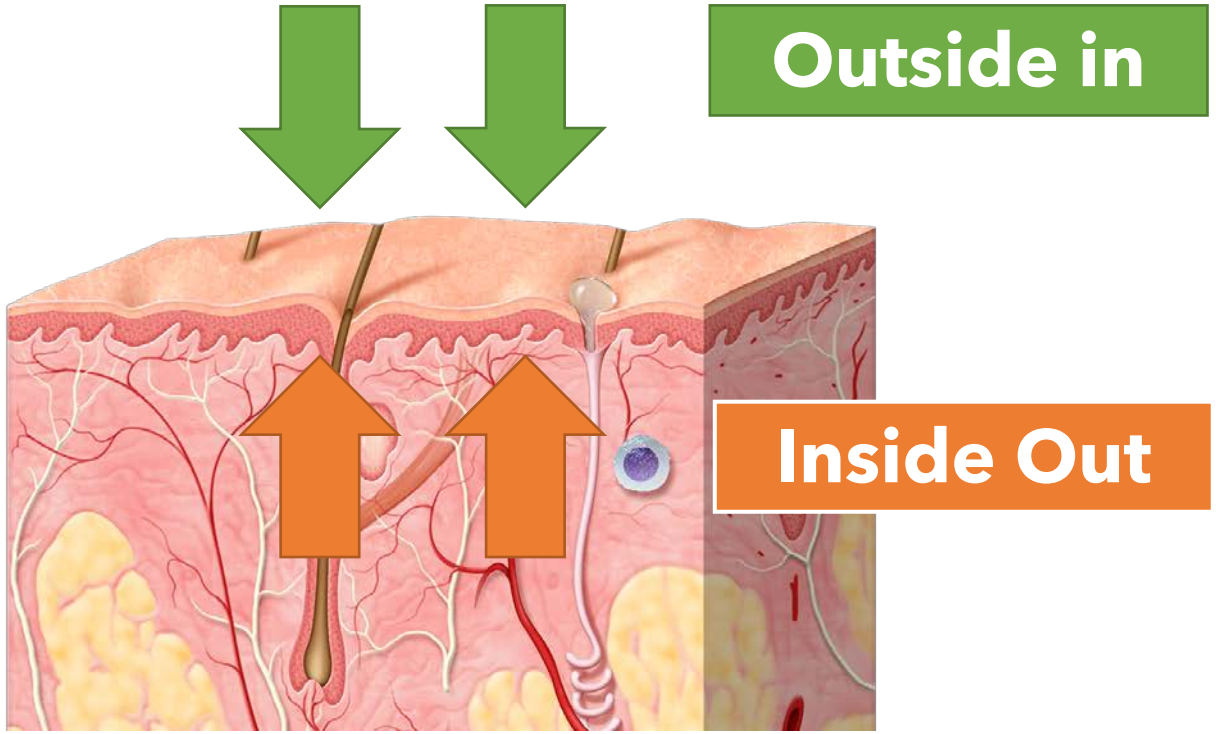
CONCEPT

Table 3. SKIN FAILURE DEFINITIONS

Author	Year	Definition
Stanley[49]	1990	Loss of barrier function
Ryan[100]	1991	Failure for the organ to function including protection, thermoregulation, sensory perception, and display
Irvine[30]	1991	Skin failure is a loss of normal temperature control with inability to maintain the core temperature and failure to prevent loss of fluids, electrolytes, and protein, with resulting imbalance and failure of the mechanical barrier to penetration of foreign materials
Isaac[111]	2004	Interference with skin function as a result of damage or loss of large areas of skin resulting in loss of barrier function, hemodynamic problems, impaired thermal regulation, and metabolic, endocrine, and hemodynamic changes
Inamadar and Palit[28]	2005	A loss of normal temperature control with inability to maintain the core body temperature and failure to prevent percutaneous loss of fluid, electrolytes, and protein, with resulting imbalance, and failure of the mechanical barrier to prevent penetration of foreign materials
Vaishampayan et al[52]	2006	A risk perceived by a doctor or a patient to life, limb, or the structure/function of an important organ of the body
Langemo and Brown[60]	2006	An event in which the skin and underlying tissue die due to hypoperfusion that occurs concurrent with severe dysfunction or failure of other organ systems
Langemo[148]	2006	Skin failure is a result of hypoperfusion, creating an extreme inflammatory reaction concomitant with severe dysfunction or failure of multiple organ systems
Saurat[48]	2007	A failure of mechanical protective functions of the skin, leading to strongly disabling fragility
Worley[170]	2007	An event during which the skin and underlying tissue die of hypoperfusion that occurs in conjunction with severe organ dysfunction or failure
Shanks et al[75]	2009	Pressure-related injury concurrent with acute illness as manifested by hemodynamic instability and/or major organ system compromise
Sibbald et al[76]	2009	An acute episode where the skin and subcutaneous tissues die (become necrotic) because of hypoperfusion that occurs concurrent with severe dysfunction or failure of other organ systems
Zutterman et al[106]	2010	A generalized, macular eruption that rapidly develops into epidermal necrosis, resulting in massive exfoliation of skin and mucosa
Warshaw[132]	2012	Skin and underlying tissue die due to hypoperfusion secondary to severe dysfunction or failure of other organ systems, resulting in sloughing
Taymouri[129]	2013	Its normal tasks and functions can no longer be performed
Scheiner et al[126]	2014	The rapid development of multiple pressure-related intact discolored areas of skin, blanchable and nonblanchable (and/or as DTI), on patients with a Braden score of 15 or less
Koskela et al[181]	2015	Skin failure in which skin and underlying tissue lose their functional ability
Delmore et al[140]	2015	Pressure-related injury concurrent with critical illness that manifests as a result of the hemodynamic instability and/or hypoperfusion that occurs as a result of organ system compromise and/or failure
Tan et al[51]	2016	Failure of the skin to perform its multiple functions
Desai and Manam[16]	2017	A loss of normal barrier function, including loss of temperature control, percutaneous fluid, protein, electrolyte loss, and mechanical barrier function
Levine[120]	2017	A state in which tissue tolerance is so compromised that cells can no longer survive in zones of physiologic impairment that includes hypoxia, local mechanical stresses, impaired delivery of nutrients, and buildup of toxic metabolic by-products
Coltart and Irvine[91]	2018	A clinical syndrome, characterized by the acute loss of normal homeostatic and barrier skin function due to a diffuse dermatologic insult
Smollock et al[153]	2018	Prolonged hypotension results in poor tissue perfusion, depriving the tissues of oxygen, nutrients, and waste removal
Wollina et al[56]	2019	A loss of normal temperature control combined with the inability to maintain the core body temperature; percutaneous loss of fluid, electrolytes, and protein; and failure of the mechanical barrier to prevent penetration of germs
Fadial[21]	2019	Derangements in normal skin function
McCamley and Singh[85]	2019	An inability of tissue to survive increased stress due to lack of reserve
Delmore et al[141]	2020	Hypoperfusion of the skin resulting in tissue death in the setting of critical illness

Skin failure: a two-faced concept



an acute condition with systemic effects and **needing interventions to restore a proper function**. It is not less severe than other organ dysfunctions such as heart, lung, kidney or liver failure

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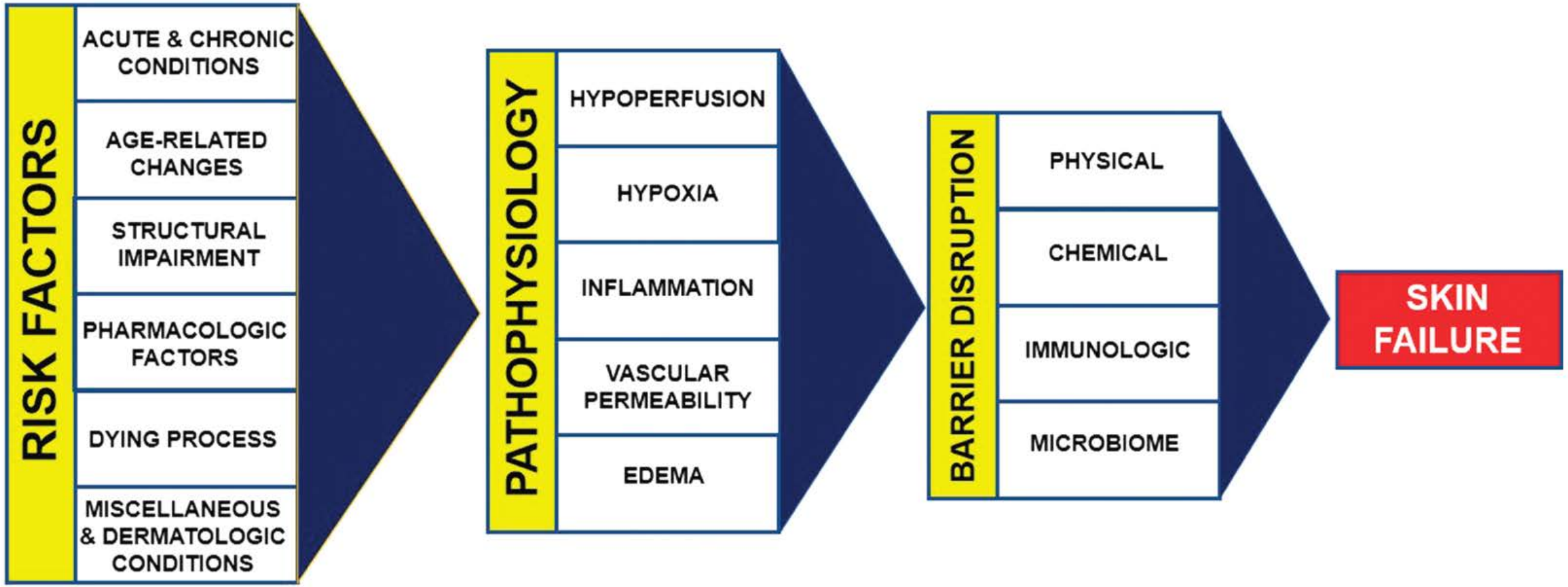
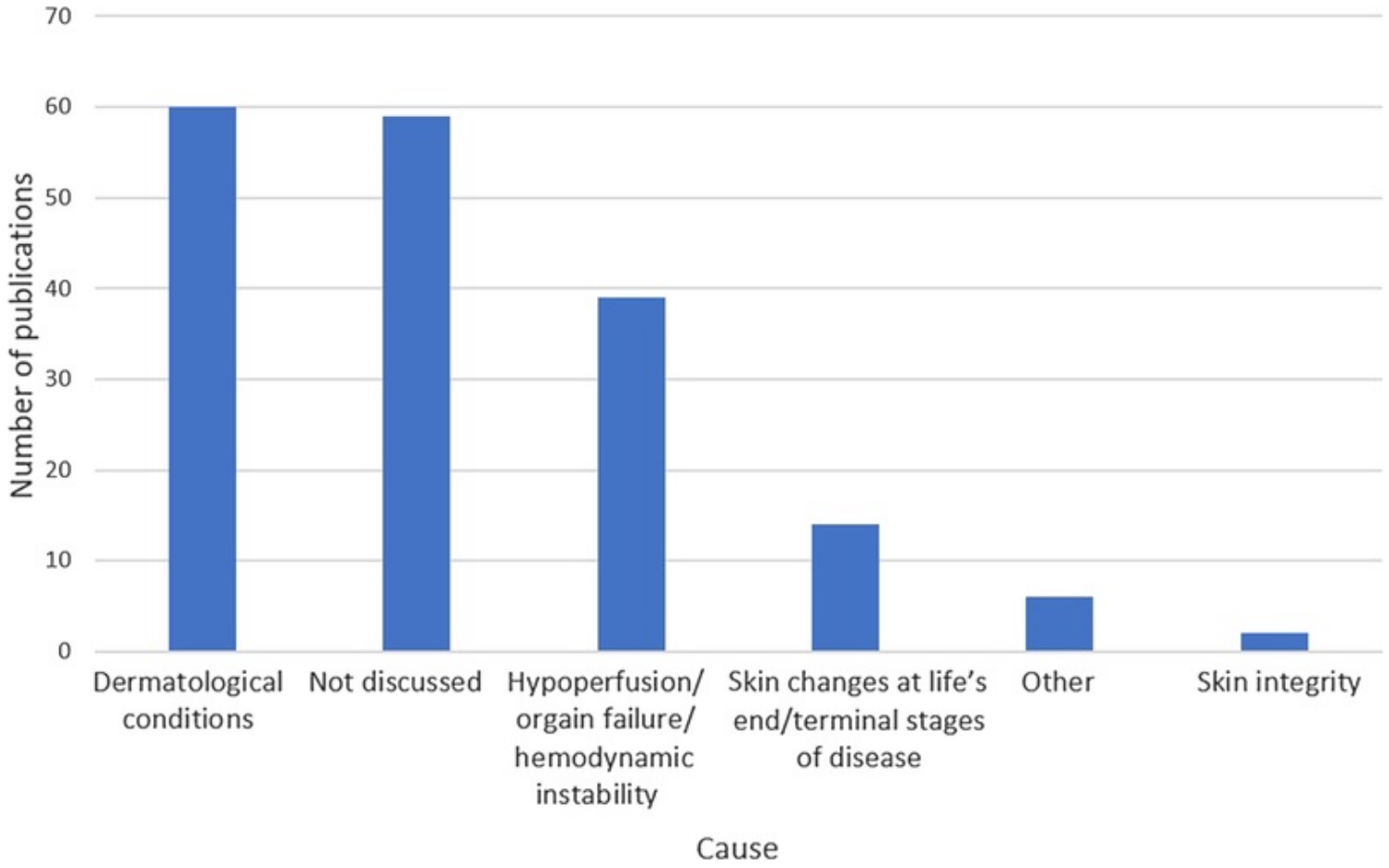
CAUSES



ADV SKIN WOUND CARE 2022; 35(3): 139-148



Cause of Skin Failure

ADV SKIN WOUND CARE 2021;34:542–50.

Social appearance

Sensation

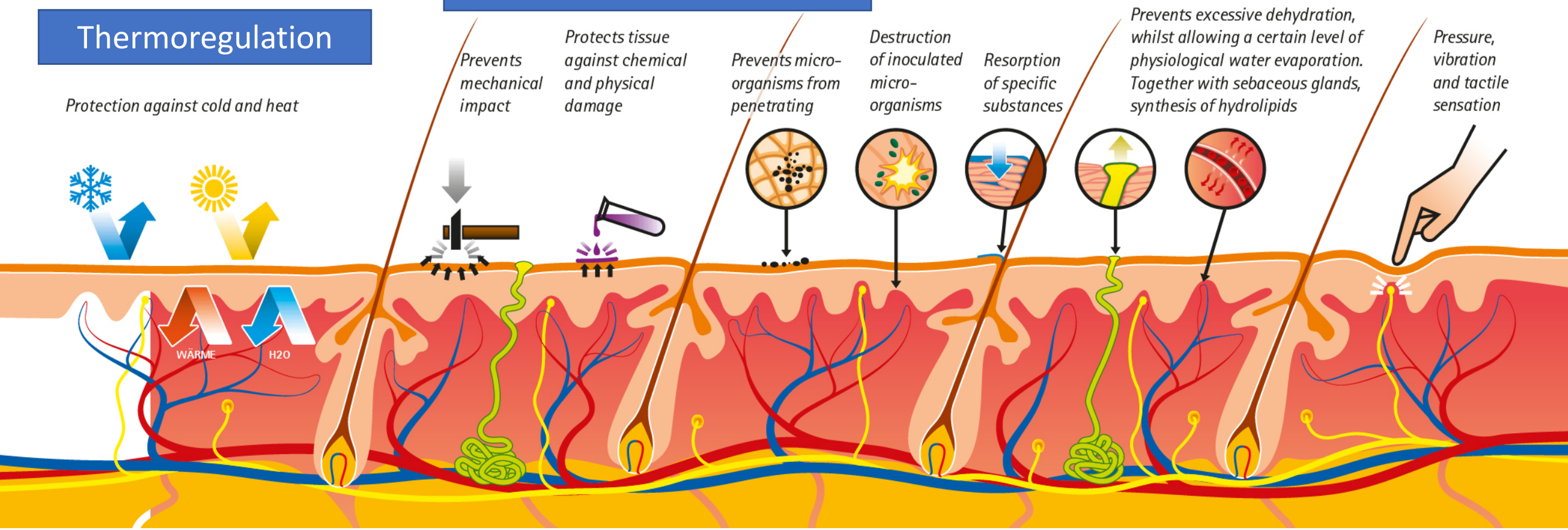
Excretion
Secretion

Vitamin D production

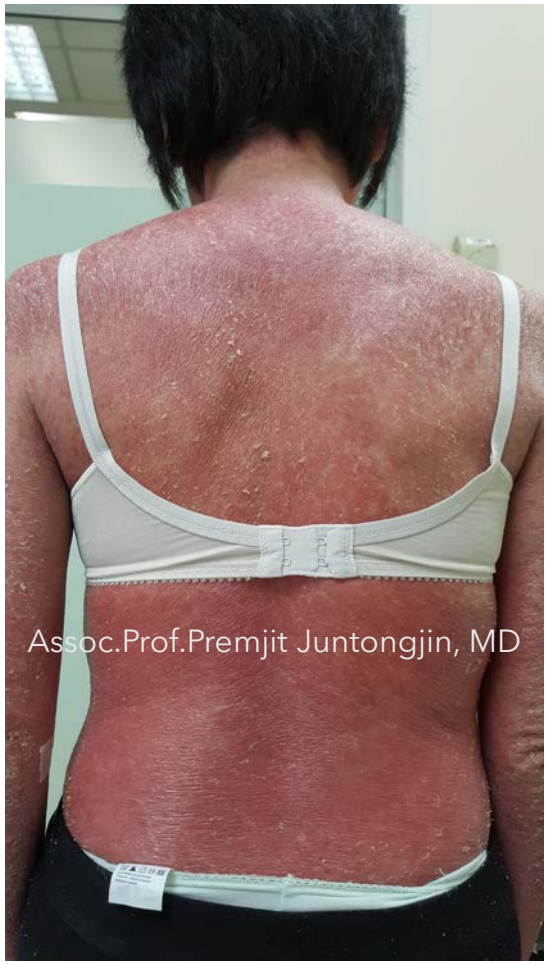
Absorption

Protection

Thermoregulation



Cases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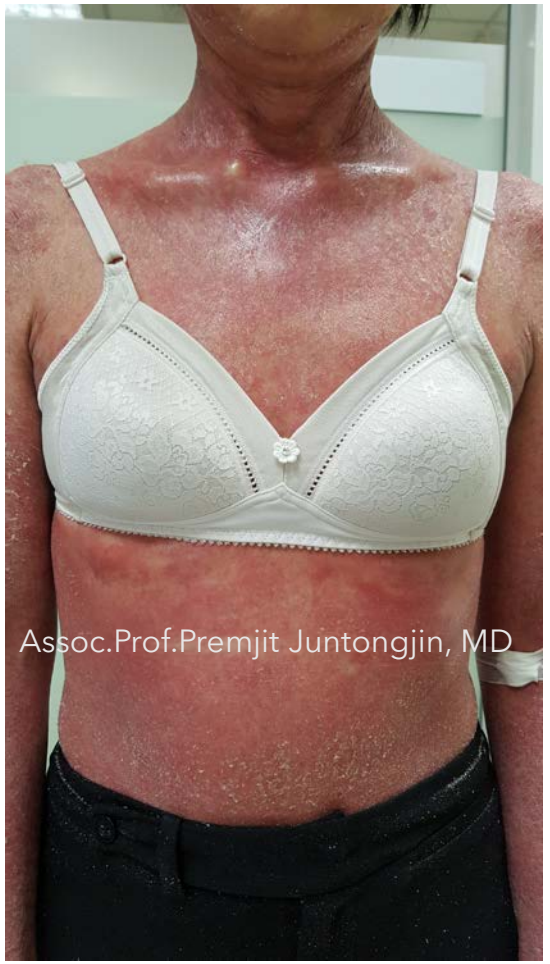
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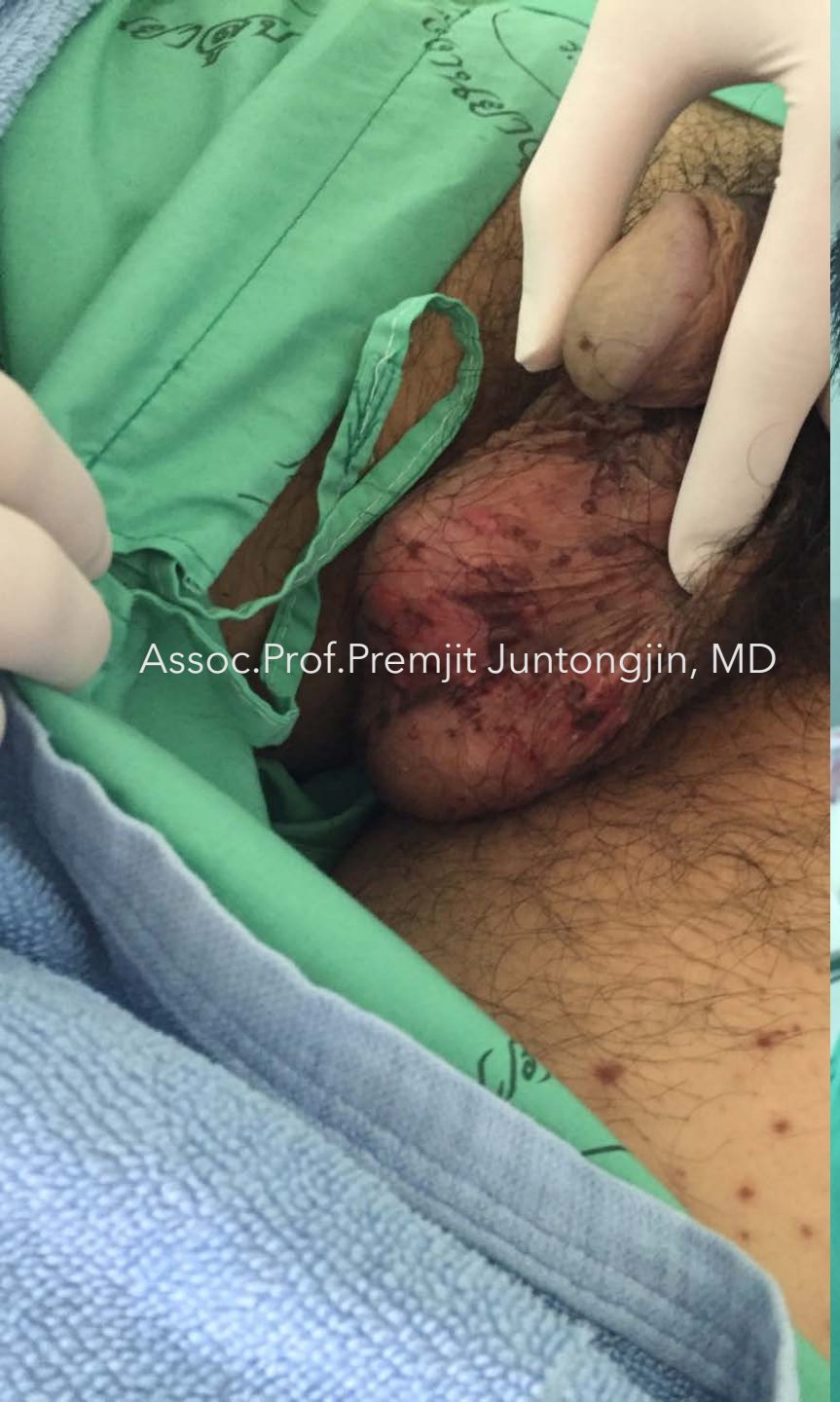
Erythrodermic psoriasis

- Life-threatening condition of psoriasis
- Chronic inflammatory dermatoses
- Pathogenesis: multifactorial
- Cutaneous lesions: skin, scalp, nail
- Extracutaneous involvement: joint, metabolic syndrome, depression
- Treatment: immunosuppressive, biologics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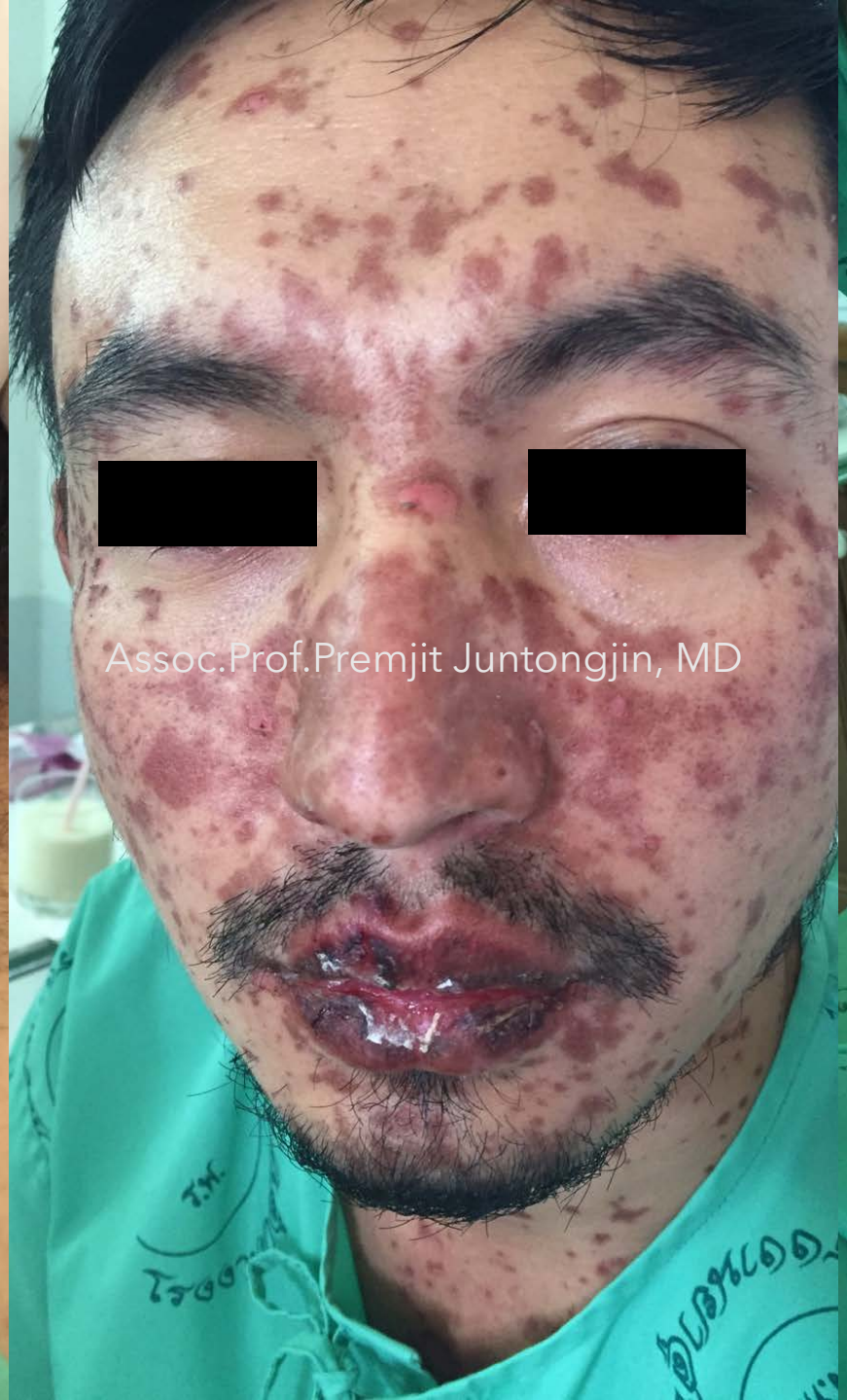
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Stevens-Johnson Syndrome (SJS)

Etiology

- **Life-threatening** full-thickness epidermal necrosis and widespread keratinocyte apoptosis
- Mainly **induced by medications** within the first 8 weeks of treatment
- May be triggered by viral or bacterial **infections**

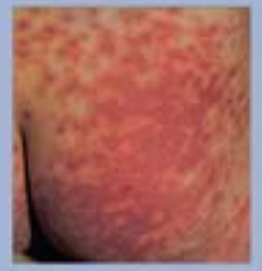
Prodrome

- Fever, malaise, headache, rhinorrhea, odynophagia, dysuria, burning of the eyes
- 1-3 days prior to eruption

Stevens-Johnson Syndrome (SJS)

Cutaneous Lesions

- **Less than 10% of body surface area**
- Symmetric, proximal > distal involvement



Atypical target lesions

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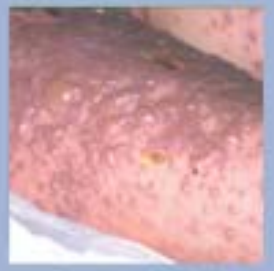

Dusky, Nikolsky + bullae

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Erosions

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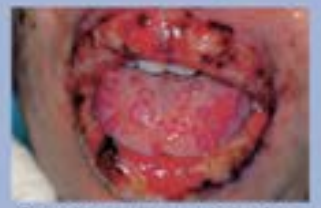
Mucosal involvement occurs in >90% of cases



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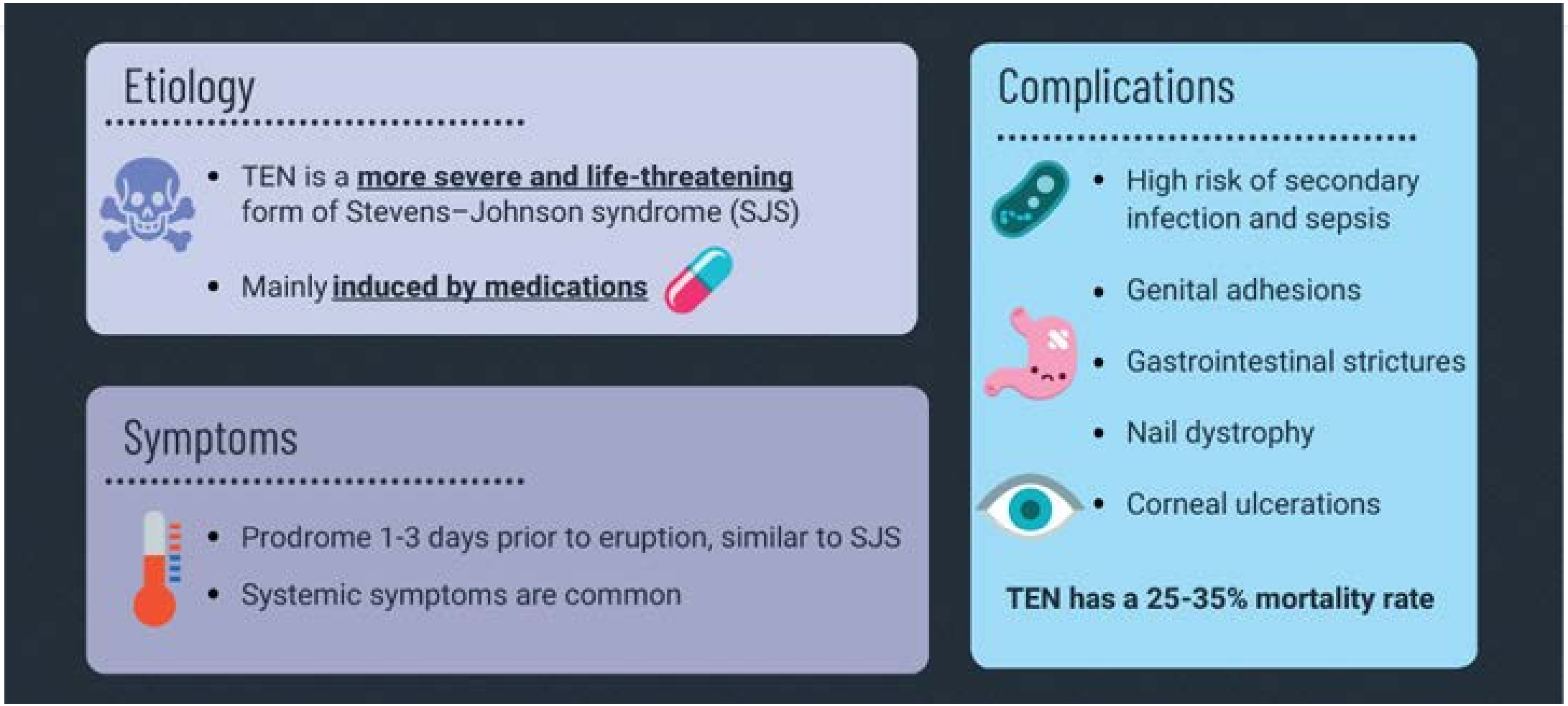
Mucosal lesions may be:

1. Oral (>90%)
2. Ocular (>80%)
3. Urogenital
4. Respiratory
5. Gastrointestinal

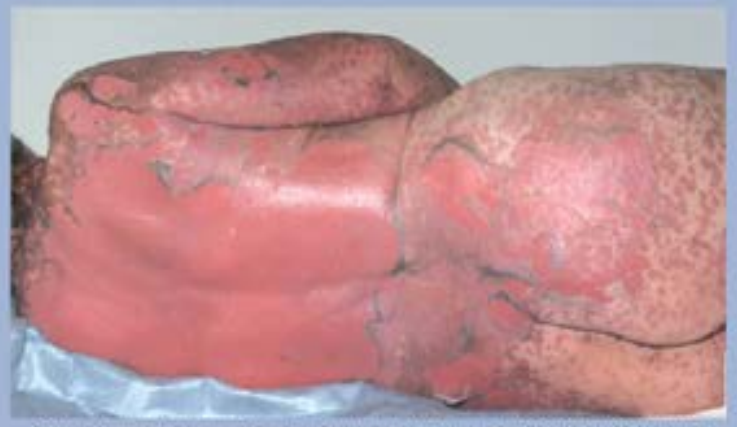
Toxic Epidermal Necrolysis (TEN)



Toxic Epidermal Necrolysis (TEN)

Cutaneous and Mucosal Lesions

- **At least 30% of body surface area** (SJS/TEN overlap involves 10-30% of the body surface area)
- Large coalesced bullae and erosions with sloughing of skin and mucosal involvement



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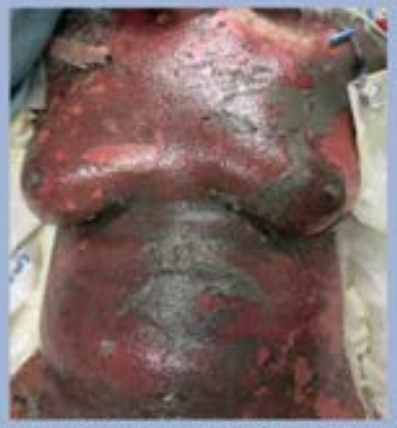

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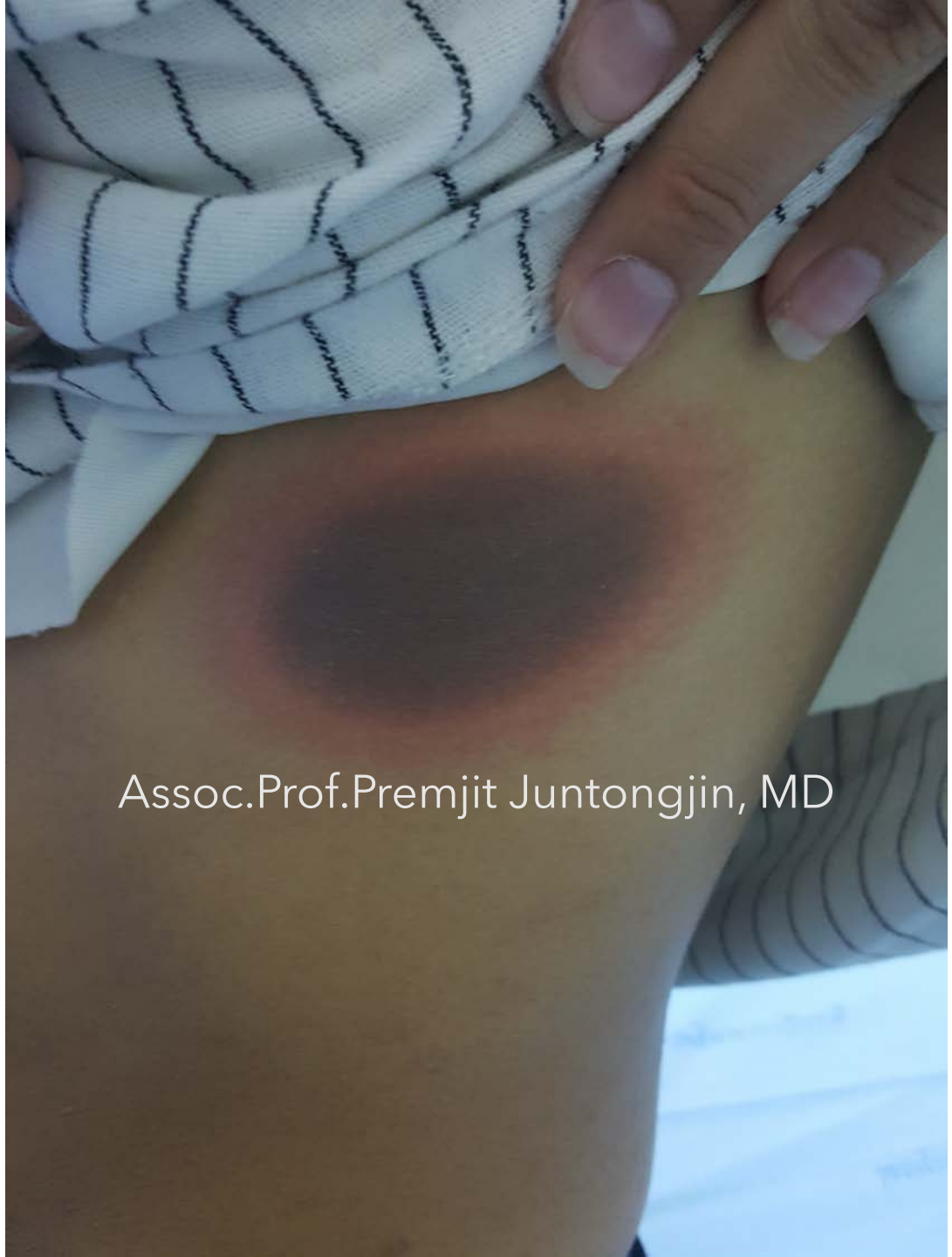
SJS/TEN

Treatment

- **Identify and remove offending agent as early as possible**
- Admission for supportive care, often in a burn or critical care unit
- Long-term ocular and urogenital follow-up
- Avoidance of similar medication agents in future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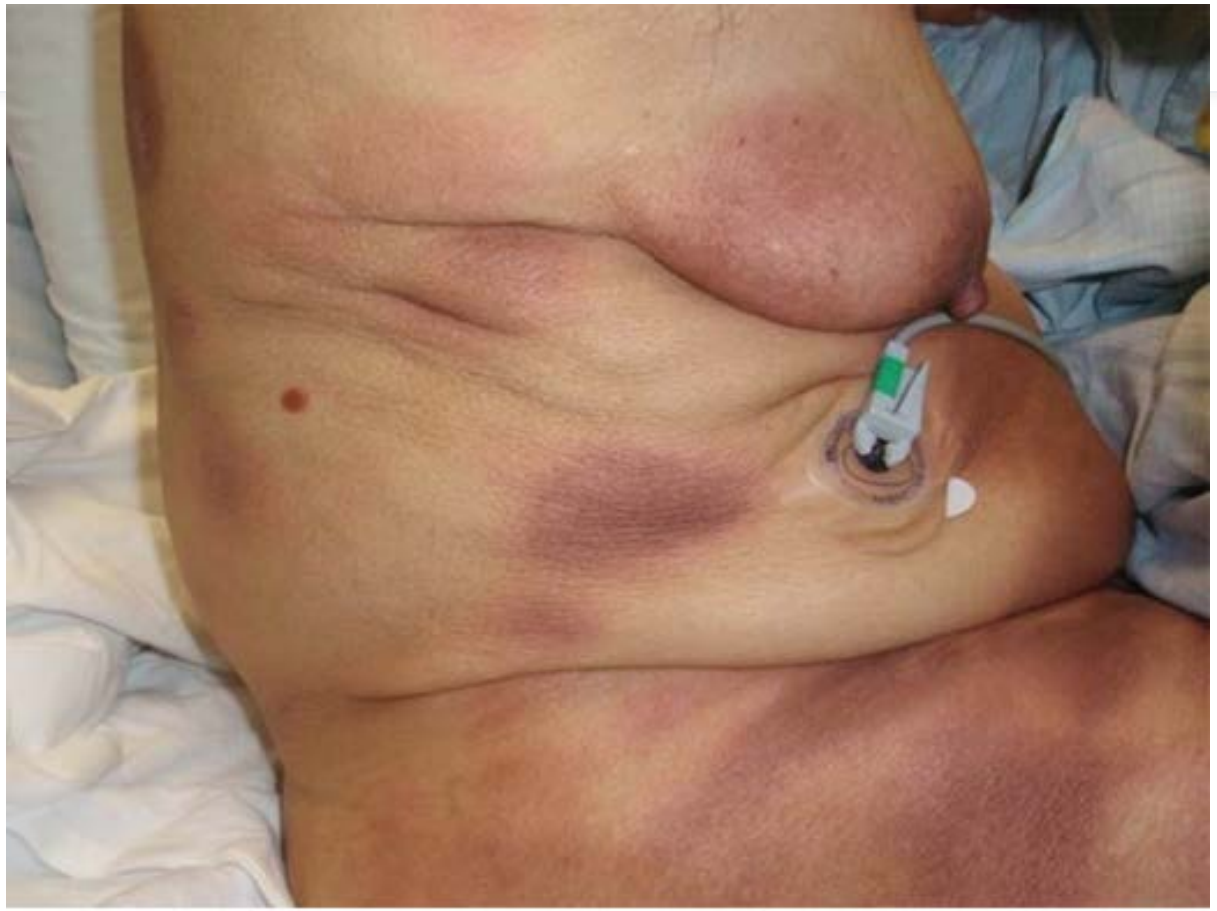
Fixed drug eruption

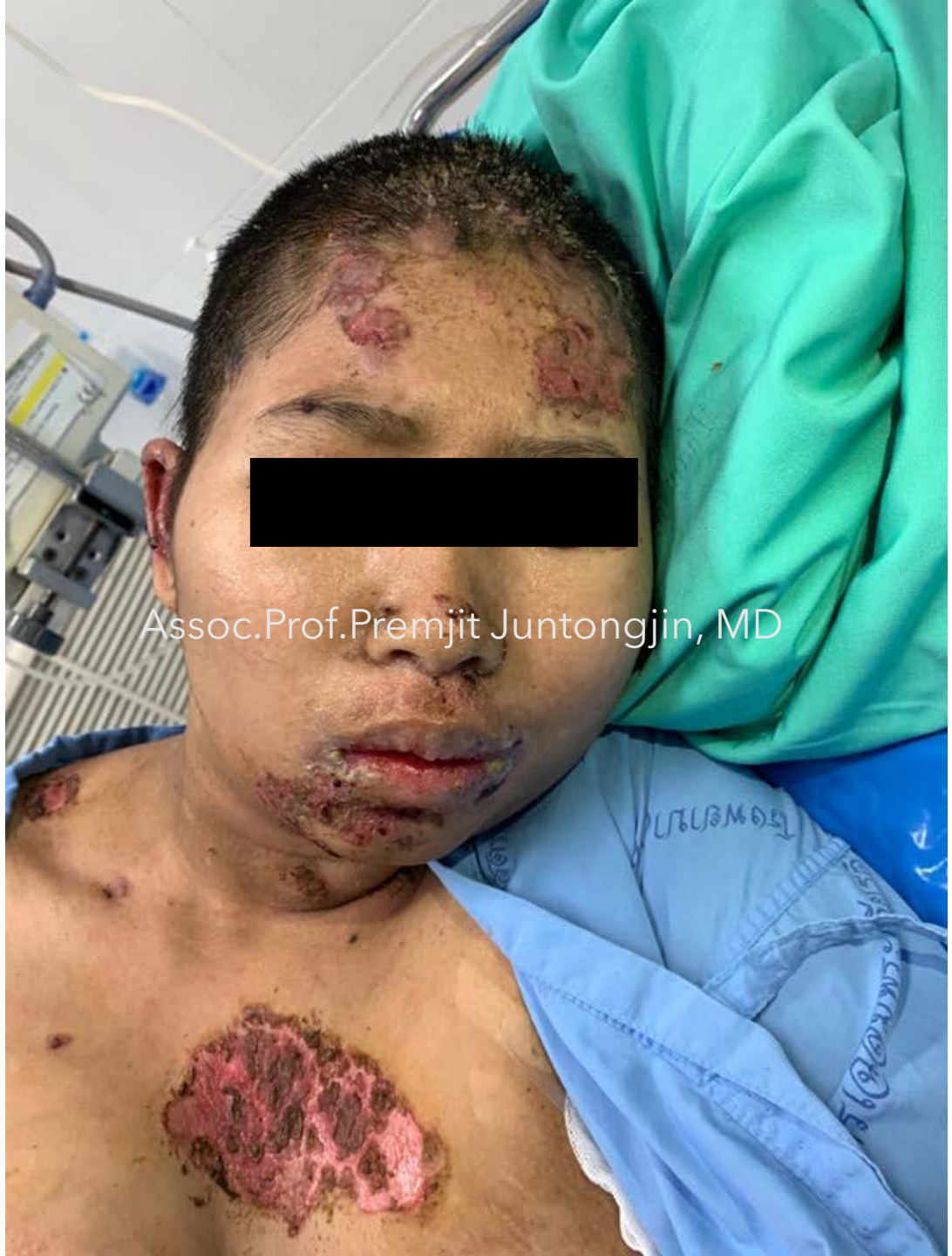
- recur in the same location: genitals, lips, hands, and feet
- appear within 24 hours of exposure to the inciting medication
- Lesions: erythematous or dark purple, round patches that may have a dusky or bullous center
- asymptomatic or burning, stinging, or pain
- resolve over the course of a few days or weeks, but often leaves residual postinflammatory hyperpigmentation

Fixed drug eruption

- NSAIDS
- Sulfonamides
- Carbamazepine
- Barbiturates
- Tetracyclines



Source: S.C. Taylor, A.P. Kelly, H.W. Lim, A.M.A. Serrano
Taylor and Kelly's Dermatology for Skin of Color, Second Edition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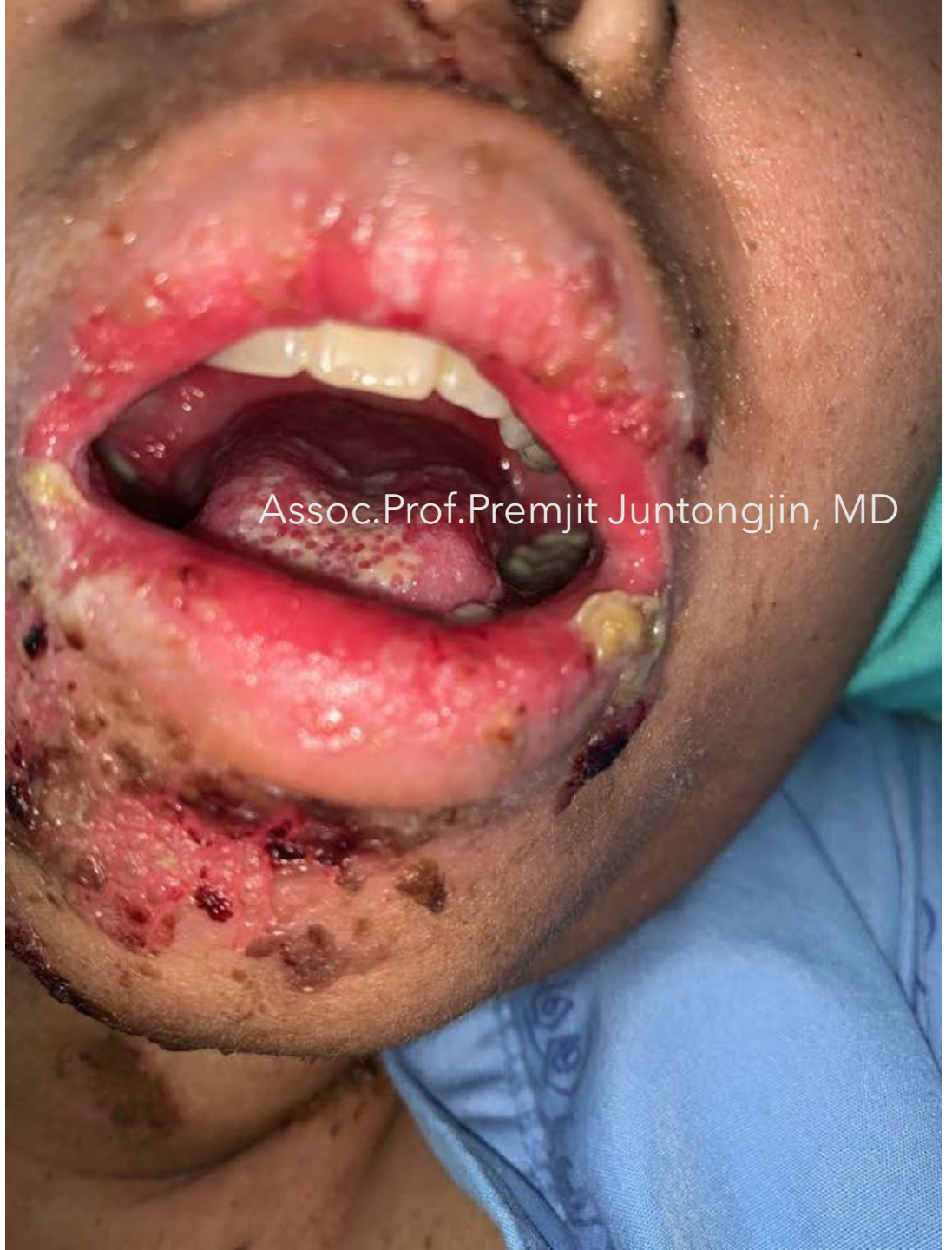
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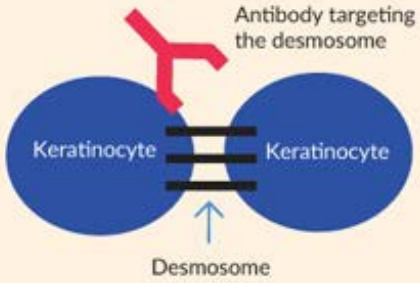
Pemphigus vulgaris

- Autoimmune blistering dermatoses
- Treatment
  - Corticosteroids
  - Immunosuppressants

Pathophysiology

- **Type 2 hypersensitivity reaction**—IgG autoantibodies target desmoglein in **desmosomes**, which hold keratinocytes together in the stratum spinosum.
- Keratinocytes in the **epidermis** separate from one another (**acantholysis**).



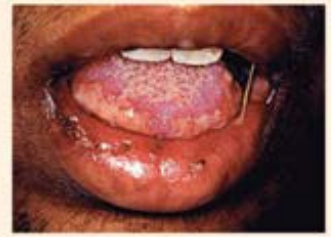
Clinical Presentation

- **Shallow, flaccid bullae** (acantholysis is superficial in the epidermis)
- **Superficial erosions** (ruptured blisters)
- **Mucosal involvement** (ie, vaginal, penile, anal, oral, conjunctival)
- Spares palms and soles

Clinical Pearl

Nikolsky's sign is **POSITIVE.**

Lateral pressure applied to the bullae causes skin shearing.



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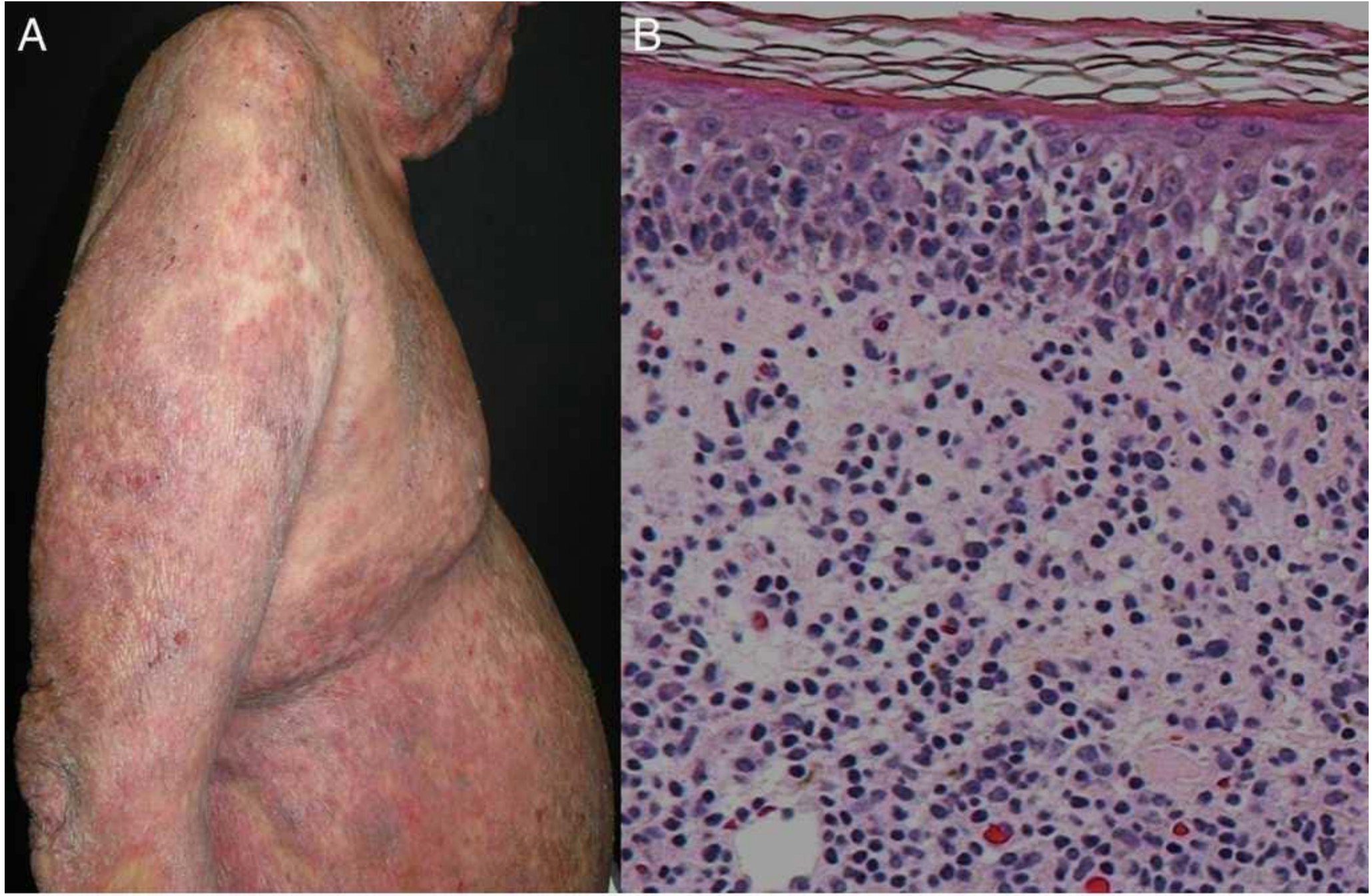
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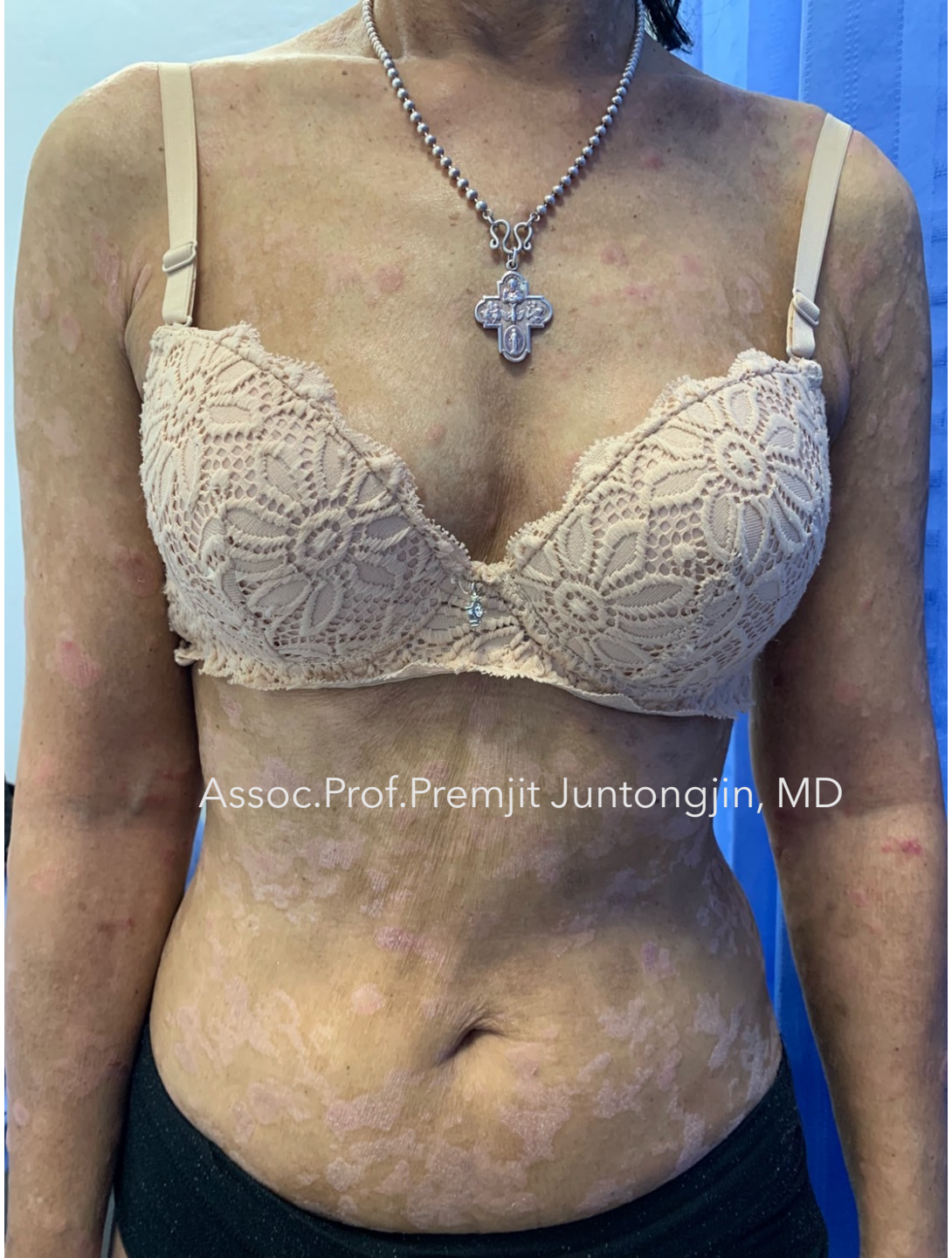
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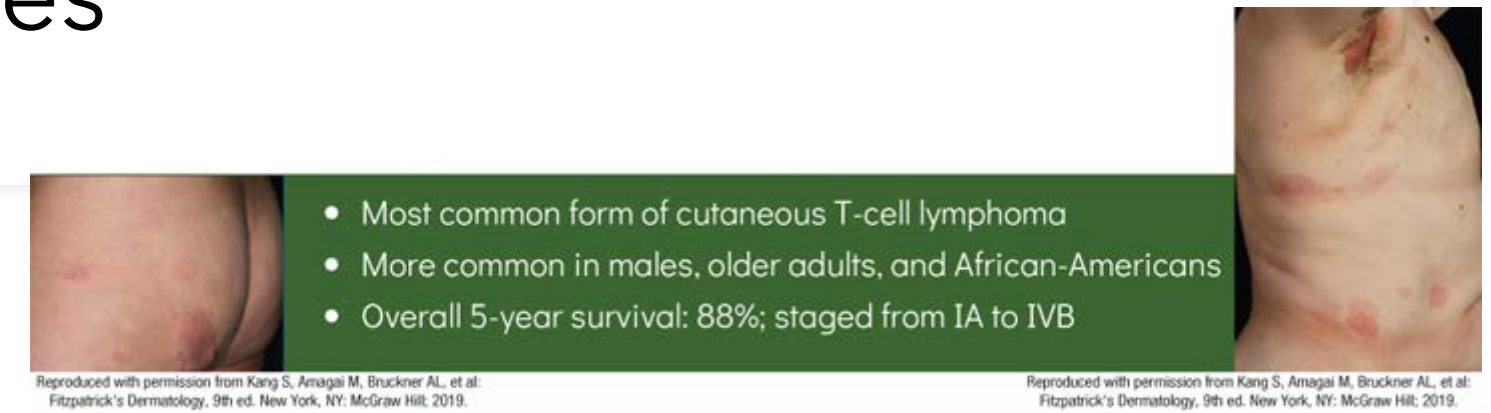
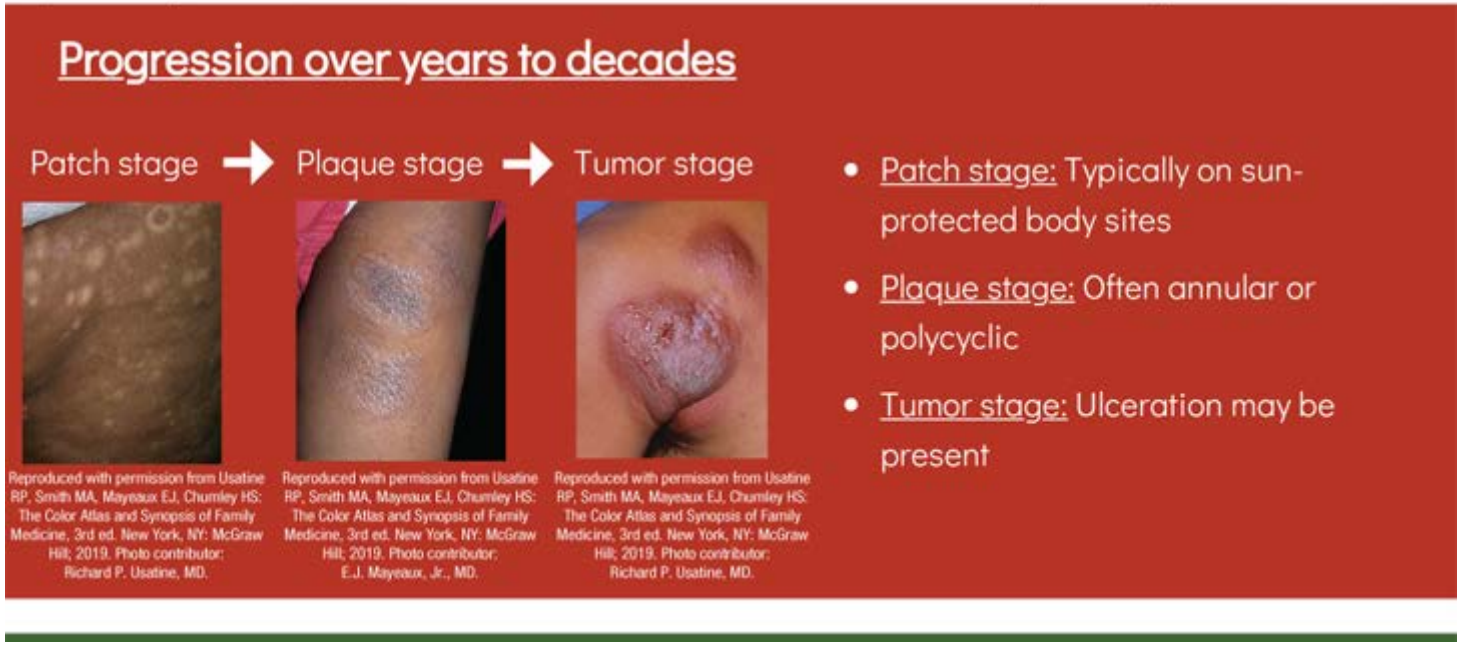
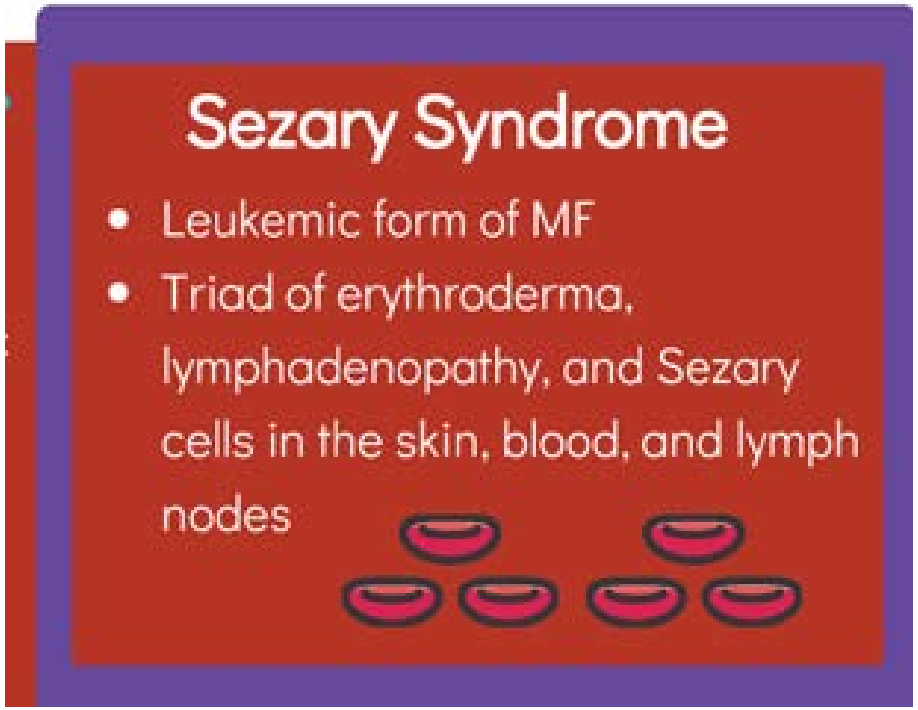
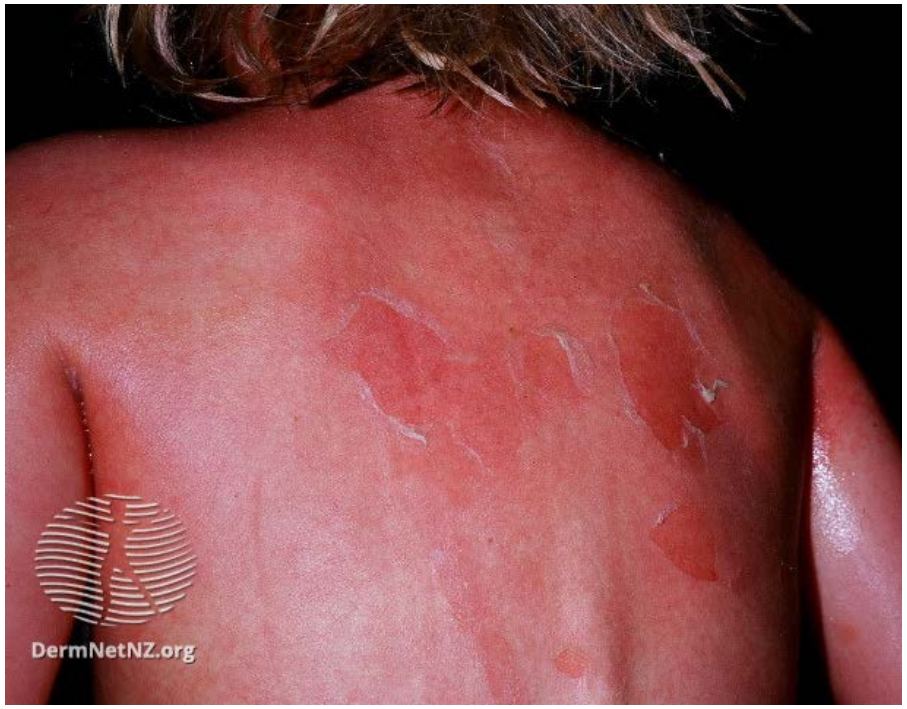
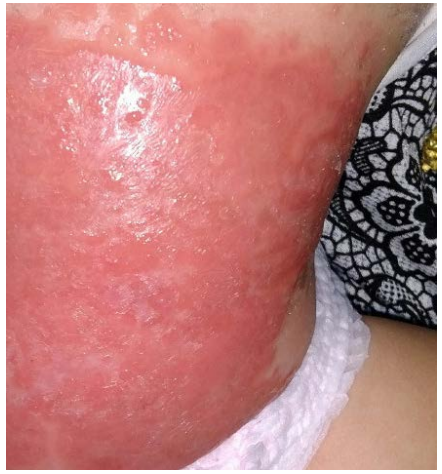
Mycosis fungoides








DermNetNZ.org

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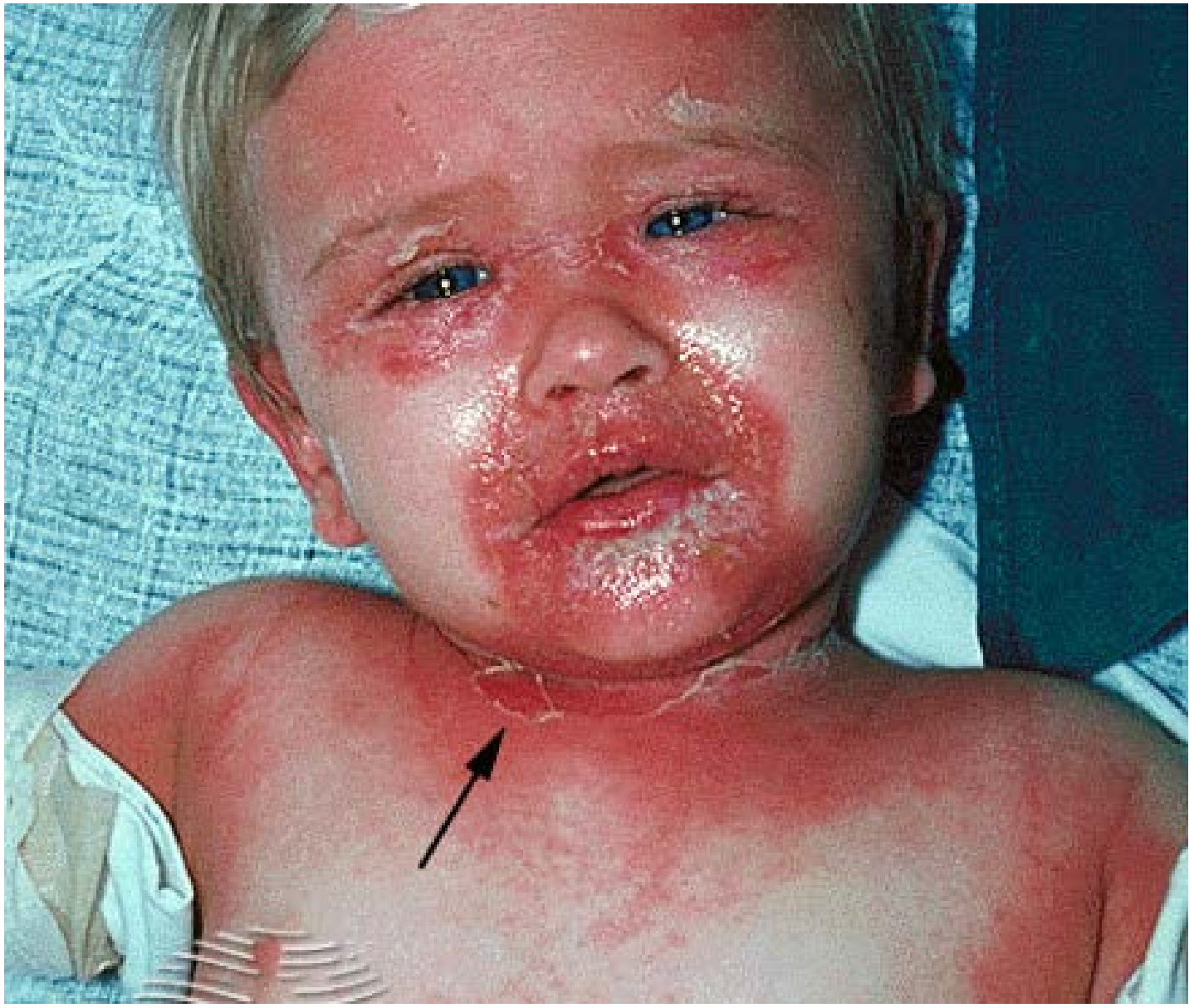
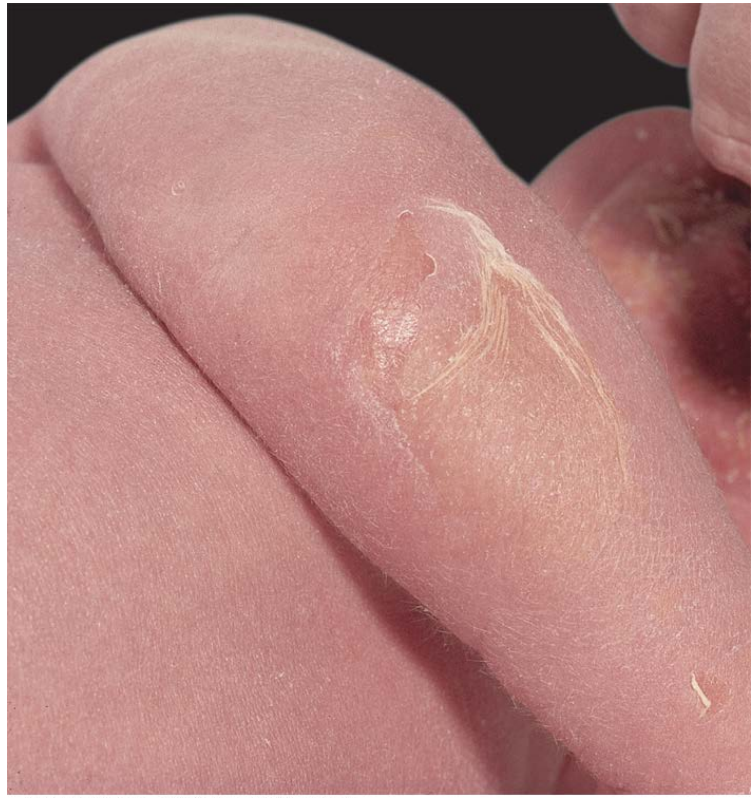
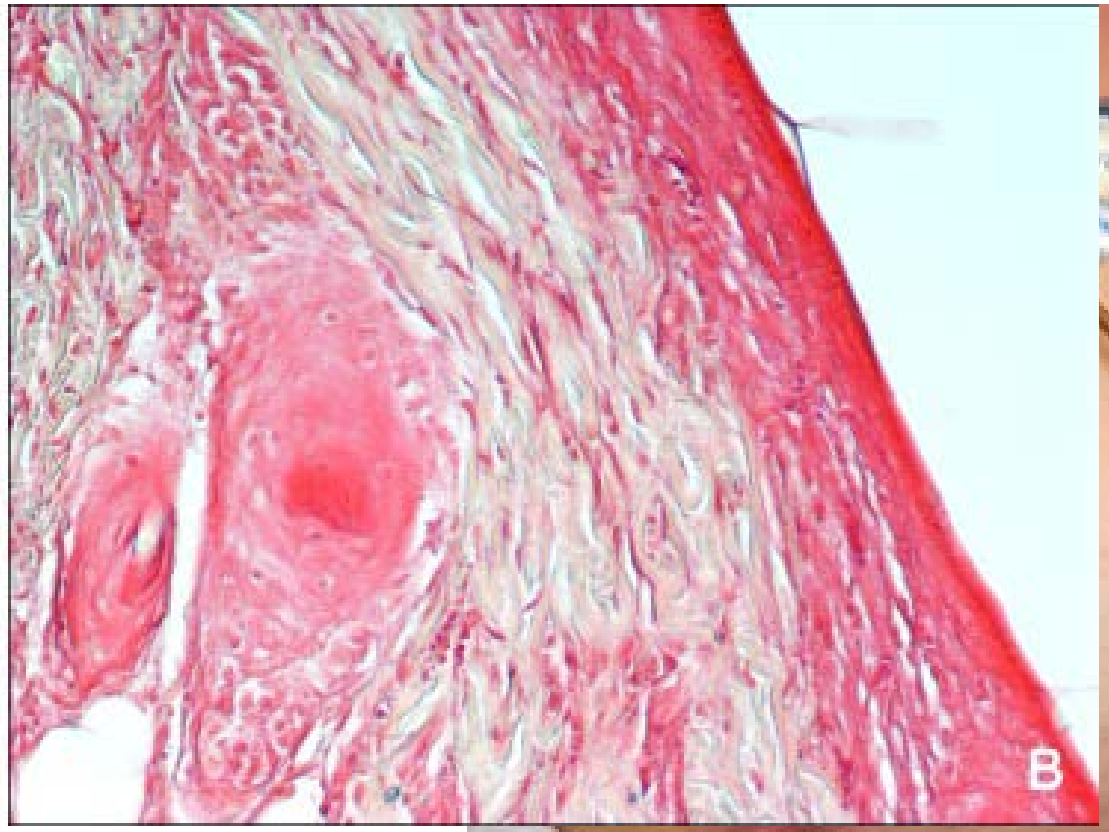


Staphylococcal Scaled Skin Syndrome (4S)

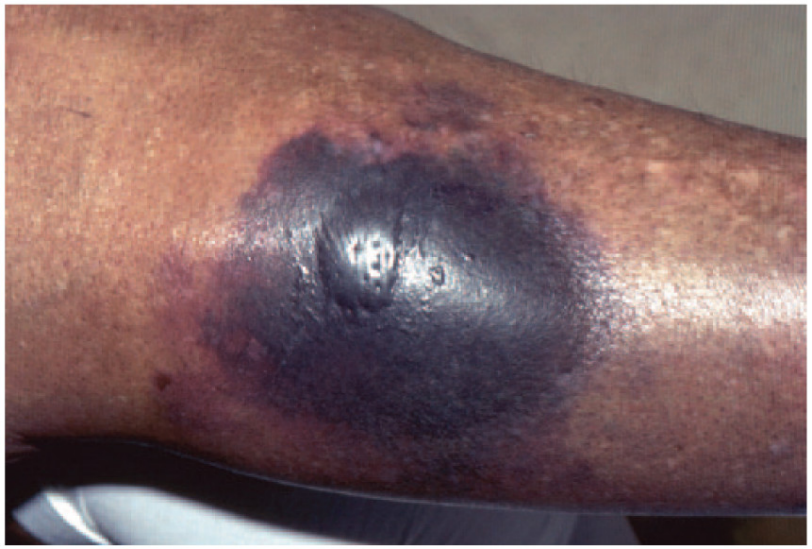
- Skin infection by Staphylococcal aureus
- Risk groups: aged <5 yrs, on immunosuppressants
- S&S: fever, malaise, perioral rash, generalized erythema, bullae and later desquamation
- Resolved in 10-14 days
- Treatment: antibiotics



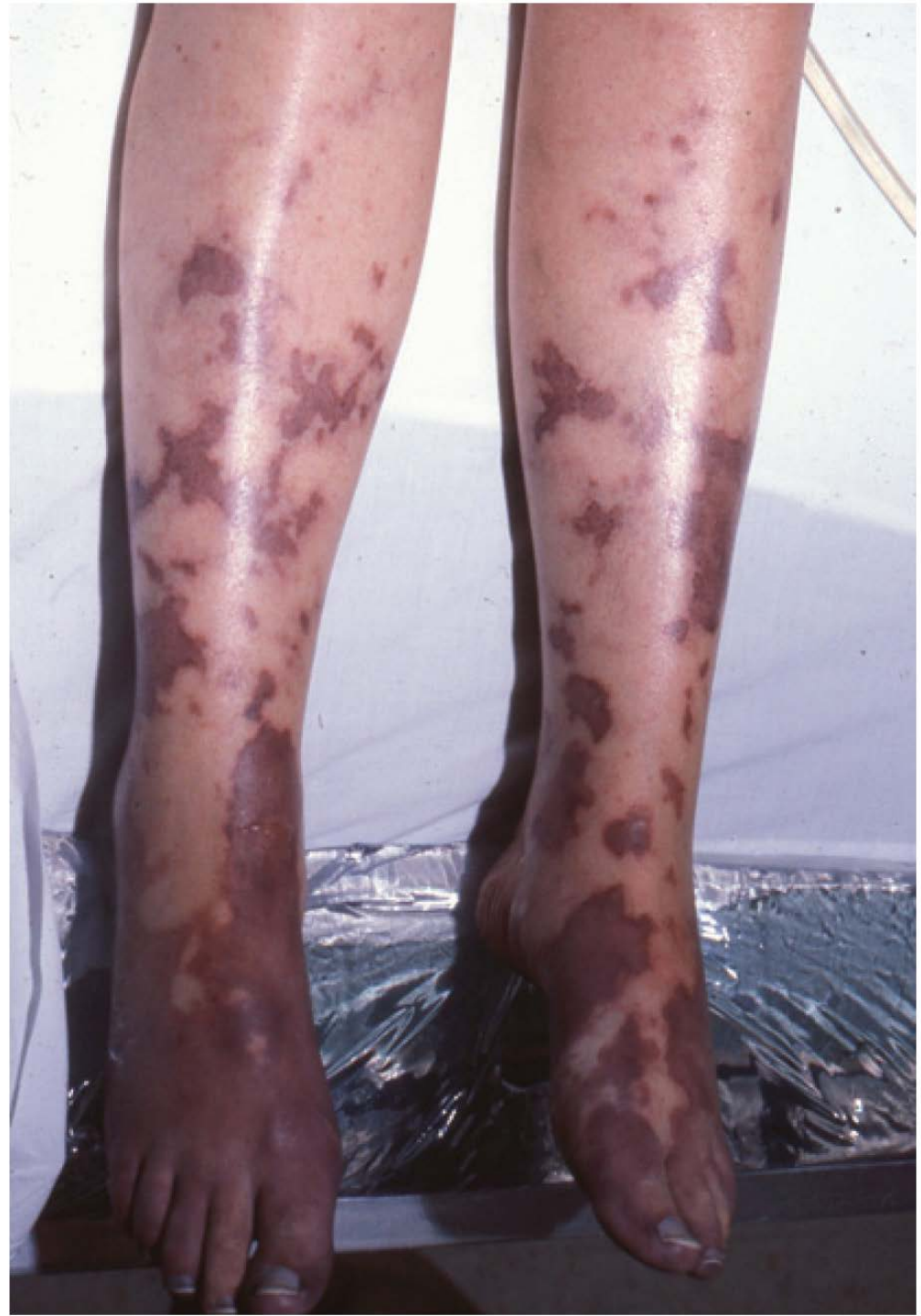


Source: Joseph Loscalzo, Anthony Fauci, Dennis Kasper, Stephen Hauser, Dan Longo, J. Larry Jameson: Harrison's Principles of Internal Medicine, 21e

Warfarin induced skin necrosis

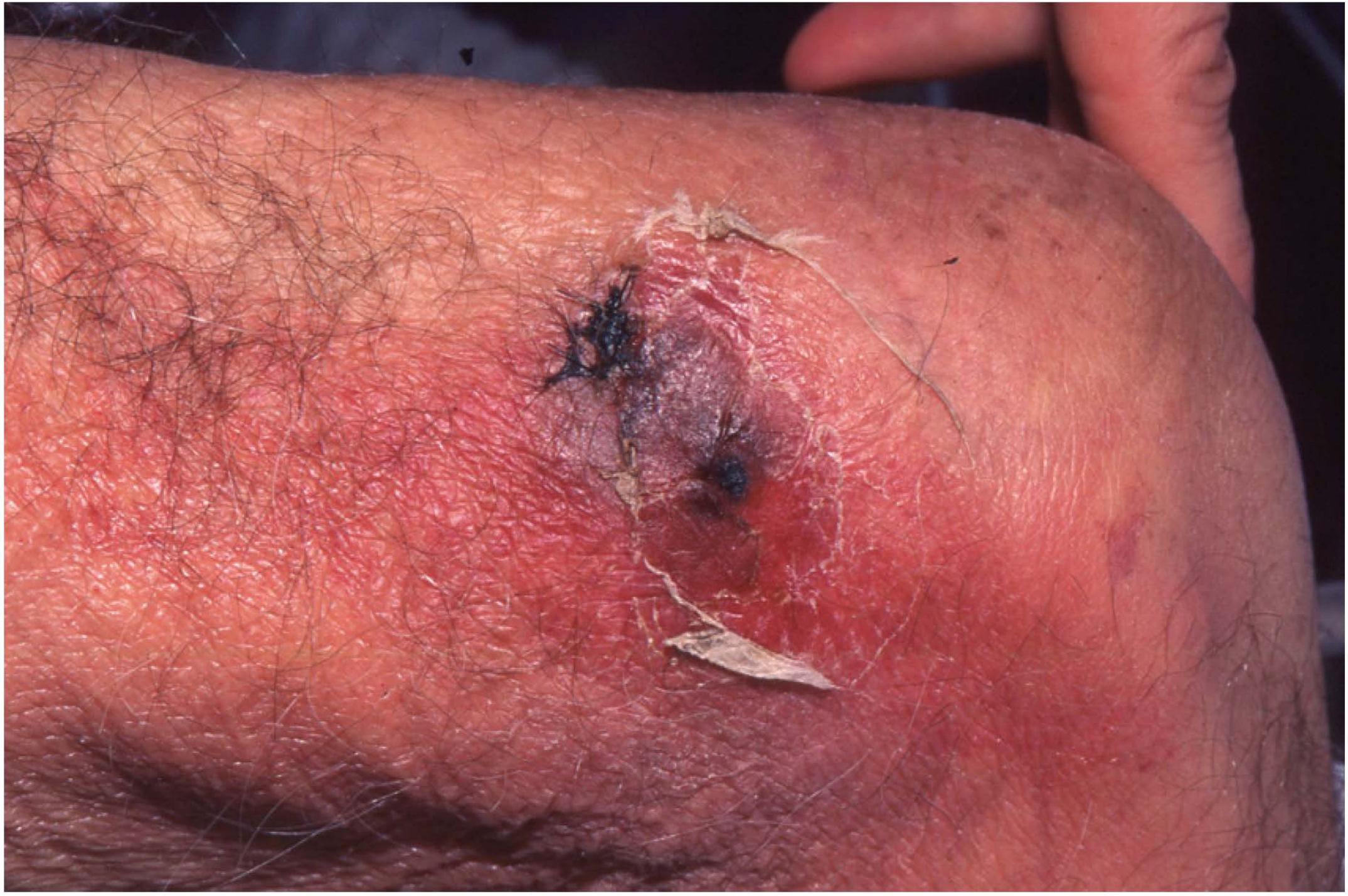


- Rare
- During 3-6 days after initiating warfarin, later necrosis in 2-3 days
- Common sites: breasts, buttocks, thighs
- Transient imbalance in the anticoagulant vs procoagulant pathways leading to a paradoxical hypercoagulable state
- Treatment
  - Prompt discontinuation of warfarin
  - FFP, vitamin K, protein C concentrate
  - Unfractionated heparin at therapeutic dose



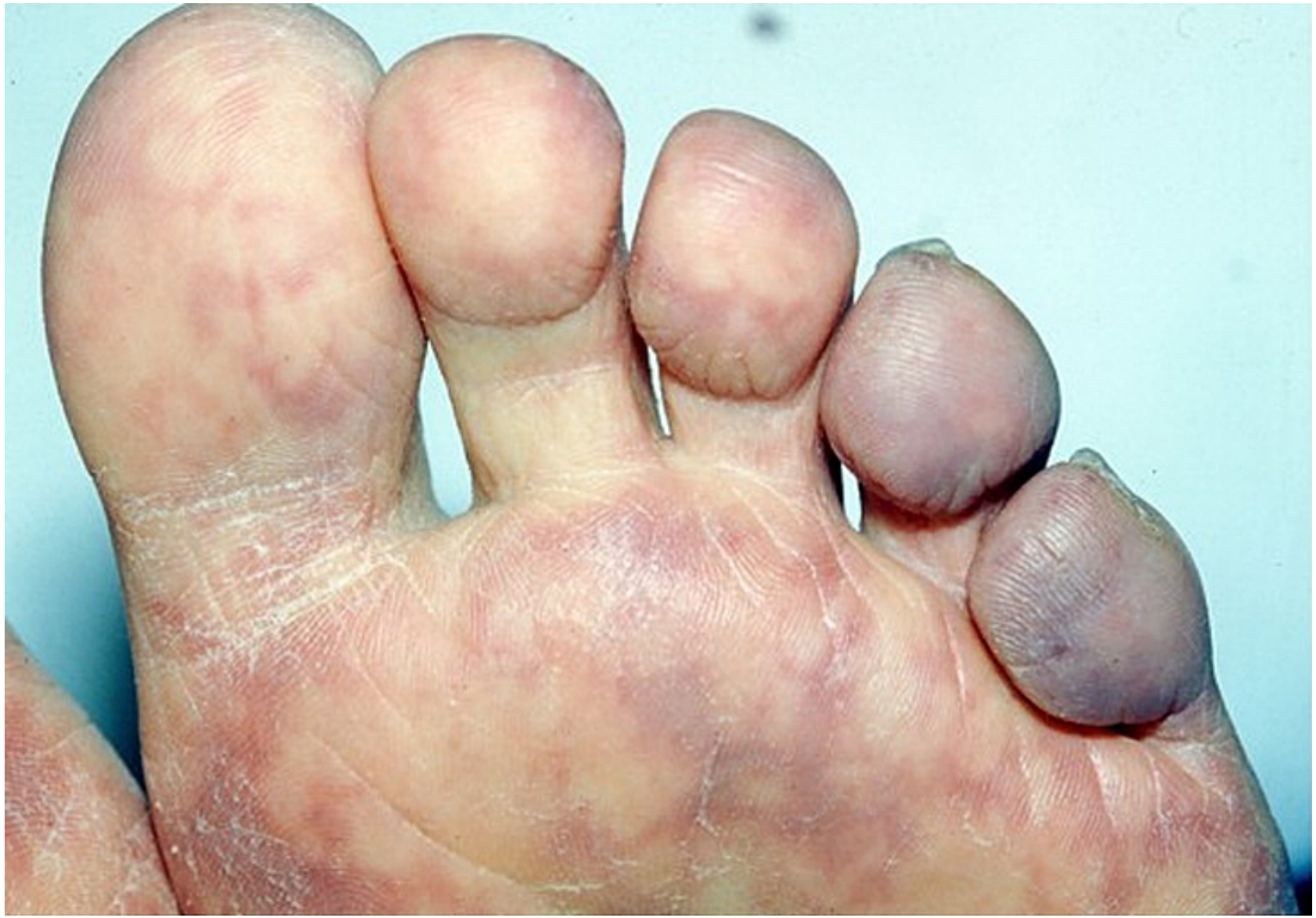
Purpura fulminans

- Sudden and life-threatening condition
- May follow previous infection: streptococcus, meningococcal, pneumococcal, gram-negative
- Cause DIC (disseminated intravascular coagulation)
- Tx: heparin, protein C, antithrombin III, tissue plasminogen activator, steroids, debridement



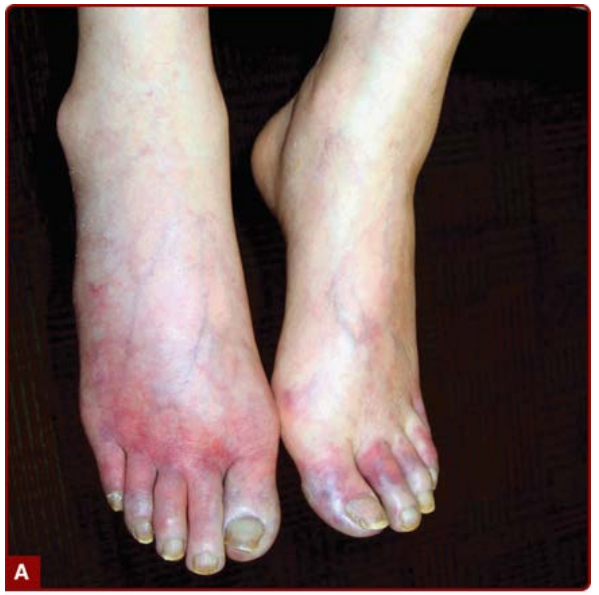
Ecthyma gangrenosum

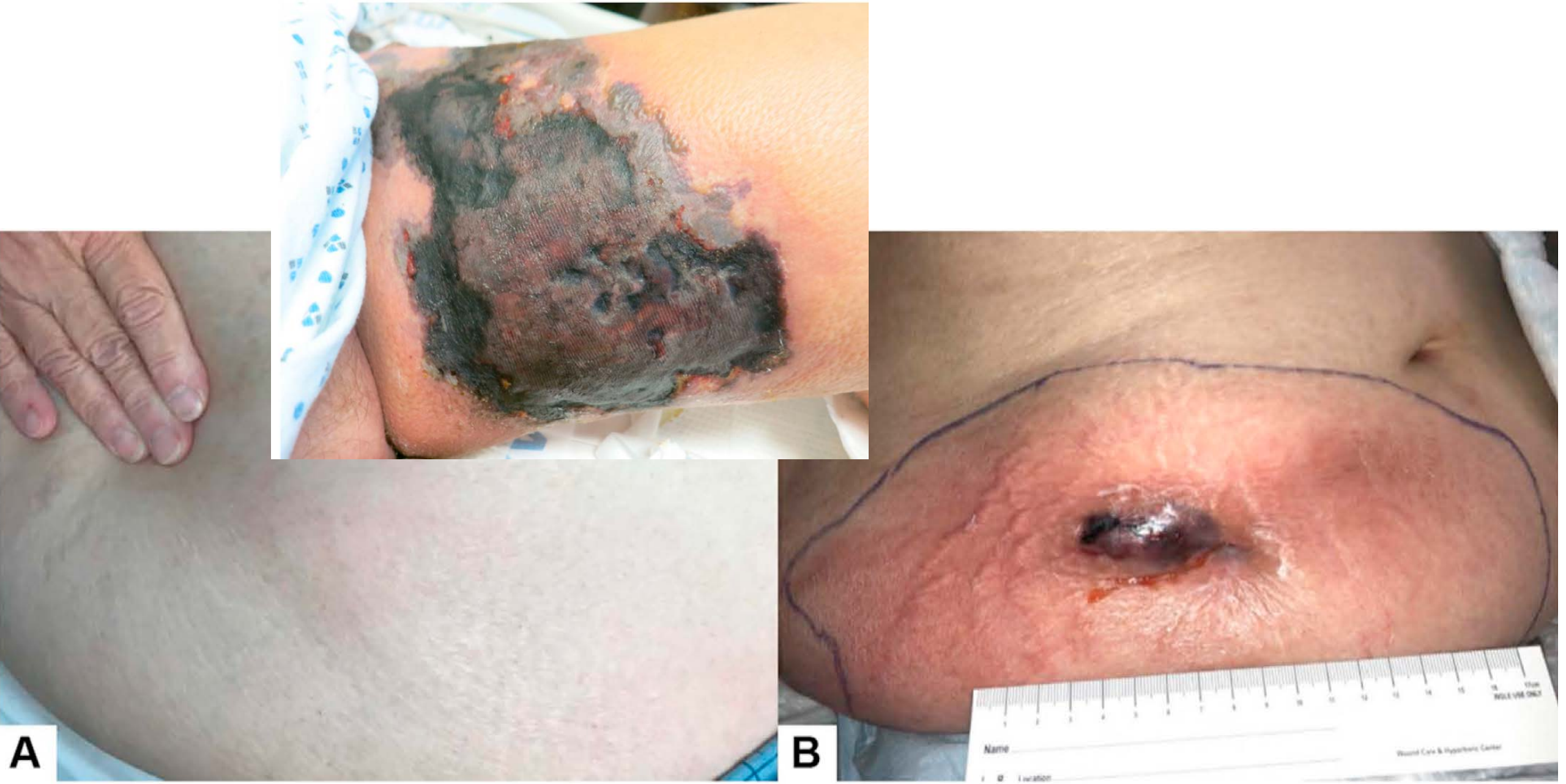
- Mainly associated with *Pseudomonas aeruginosa* bacteremia
- Risk factor: immunocompromised host
- At site of inoculum or widespread
- Lesions: painless, erythematous macules w rapid progression into bullae, evolving into gangrene, ulcer, eschar
- Tx: ATB for sepsis



Blue toe syndrome, Cholesterol embolism

- embolization of atheromatous debris from the more proximal arteries
- Risk: advanced age, after invasive procedures
- Clinical: blue or discolored toes, livedo racemosa, gangrene, necrosis, ulceration, and fissure
- Diagnosis: skin biopsy, kidney biopsy
- Complication: Renal failure, Stroke
- Tx:
  - antiplatelet therapy
  - statin

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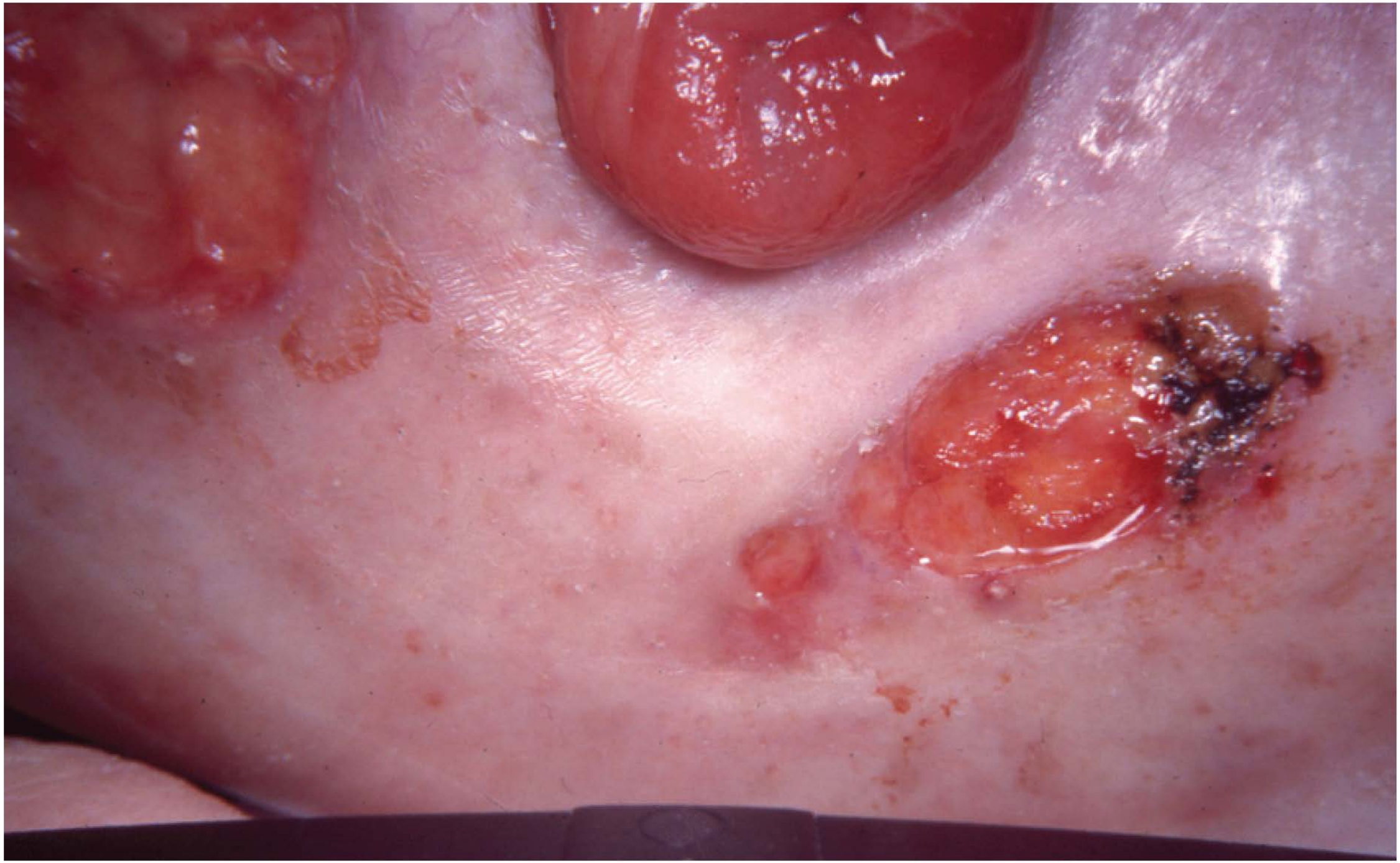
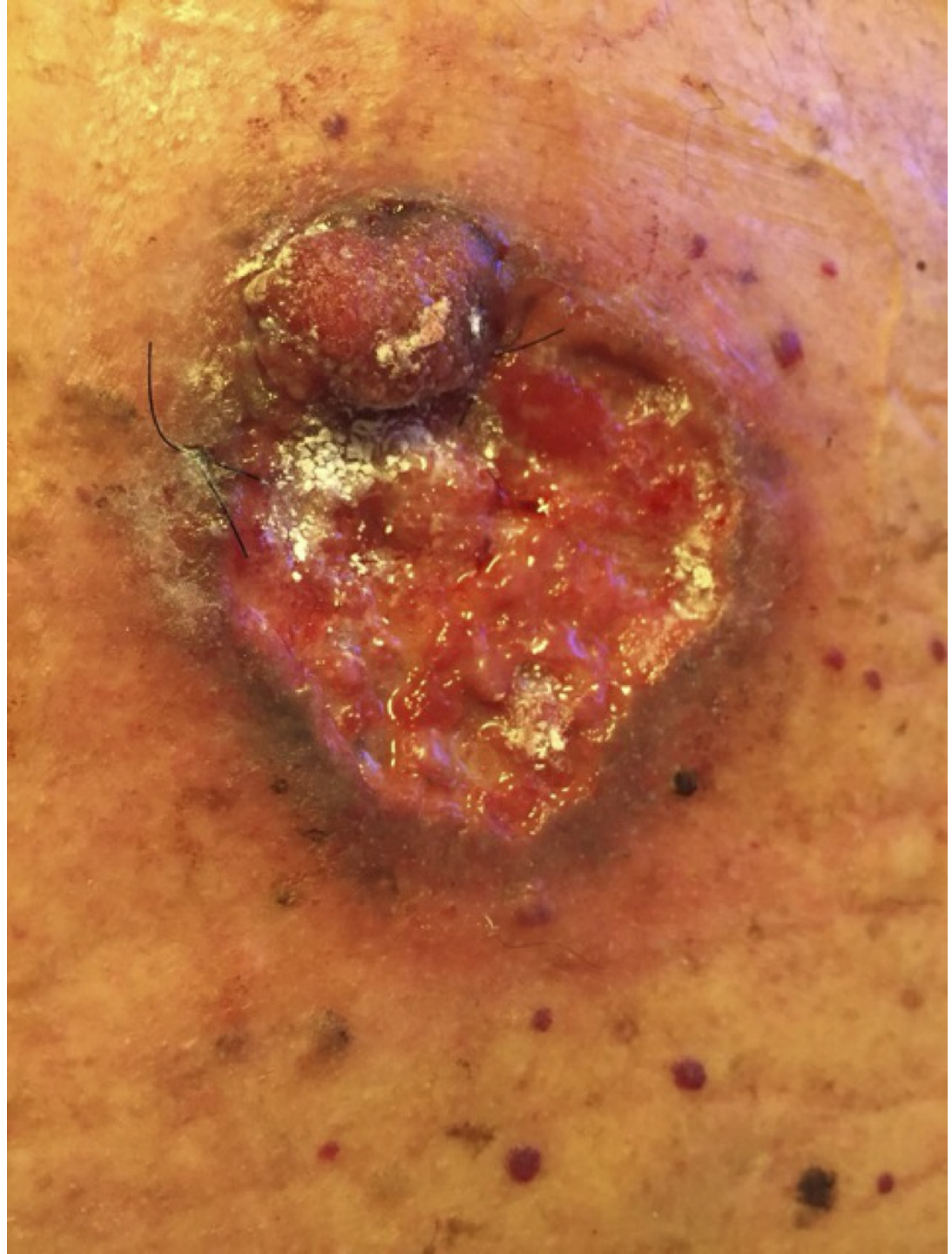
Calciphylaxis

- Metastatic calcification of small blood vessels
- Risk factor: ESRD, hyperparathytoid
- Common sites: breast, abdomen, buttocks, thighs
- Lesions: mimic panniculitis, later necrosis
- Dx: biopsy
- Tx: discontinue calcium, vitamin D, iron, warfarin, steroids
  - hemodialysis, sodium thiosulfate, bisphosphonates
  - Hyperbaric oxygen
  - NOT systemic steroids



Pyogenic granuloma

- Ulcerating neutrophilic dermatosis
- May associate with IBD, malignancy, HCV, lymphoproliferative disorders, RA
- May develop following PTU or at surgical sites
- Dx by exclusion
- Tx: Corticosteroids, immunosuppressants



Marjolin ulcer

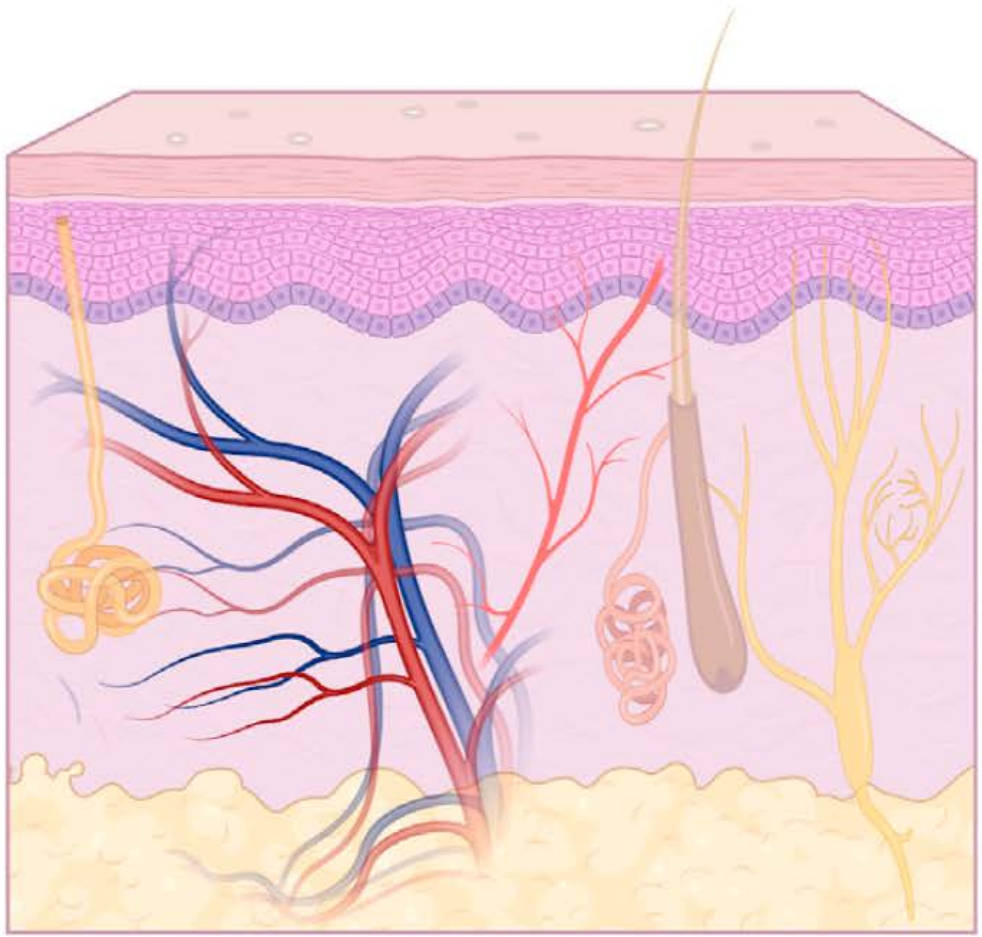
- SCC arising in burn scars
- Aggressive malignant degeneration in any chronic wound
- Up to 2% of chronic wounds/burn scars

Table. CLINICAL INDICATIONS OF MALIGNANT DEGENERATION[1,2,10,12,18–20]

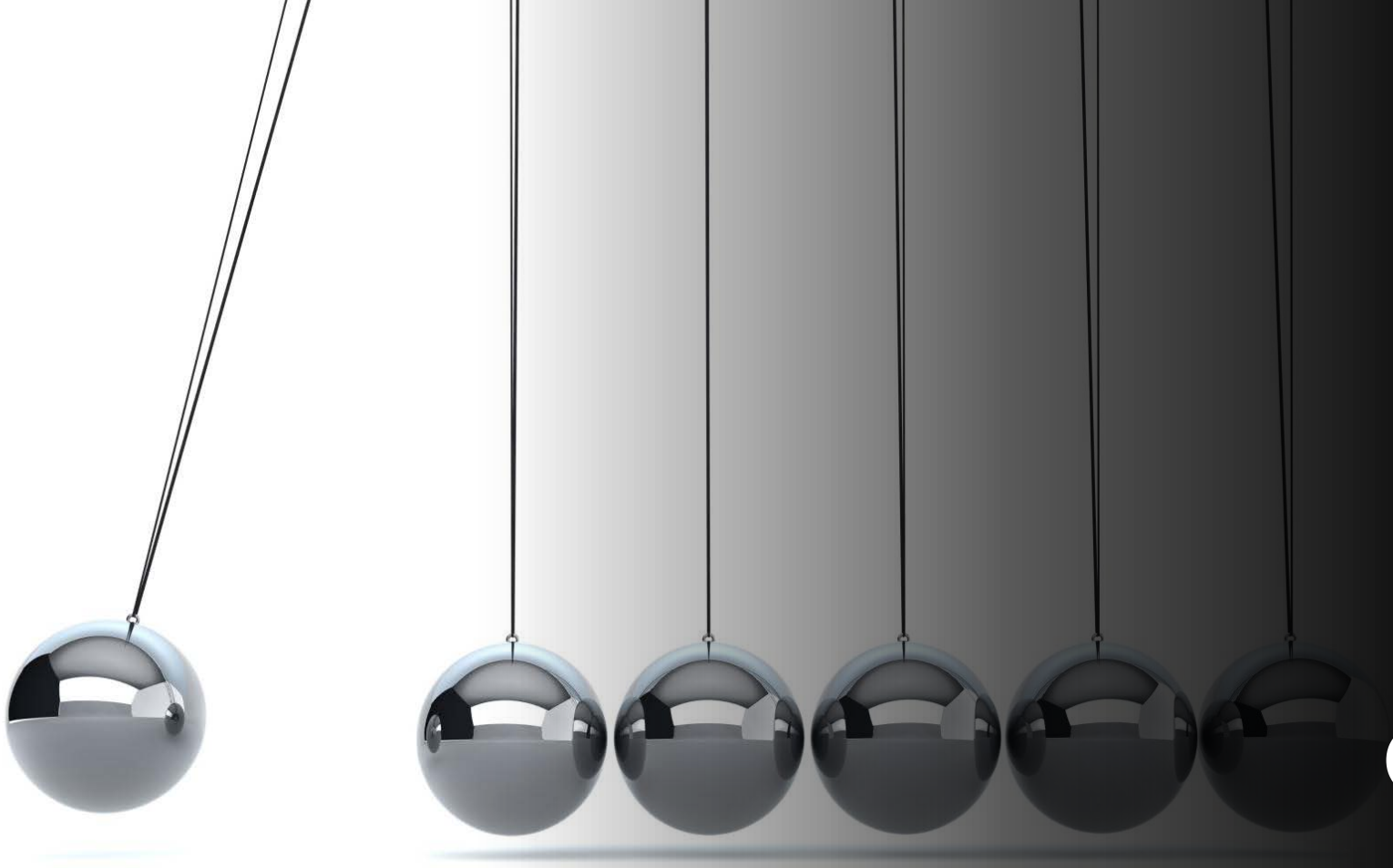
• Chronic ulceration longer than 3 months' duration
• Exophytic granulation tissue formation
• Everted or rolled margins
• Protracted wound course despite appropriate treatment
• Excess bleeding
• Malodorous discharge
• Spontaneous pain
• Regional lymphadenopathy
• Irregular margins
• Change in wound drainage

Note: A combination of these findings will likely be more reliable than single findings.

ADV SKIN WOUND CARE 2020;33:629–34.



Skin Layer	Diagnostic Pattern	Differential
Epidermis	Ulceration (commonly dry)	Pyoderma gangrenosum, venous or arterial ulcer disease, small/medium vessel vasculitis, or ulcers from cutaneous bacterial or atypical (fungal, mycobacterial) infection, pressure
Dermis	Retiform Purpura	Angioinvasive organisms, small/medium vessel vasculitis, cryoglobulinemia, Vitamin K antagonist-induced necrosis, septic emboli, disseminated intravascular coagulation; or primary hypercoagulable disorders like Protein C deficiency, Protein S deficiency, or Factor V Leiden deficiency, pressure
Subcutis	Tenderness and Deep Induration	Panniculitides, such as those seen from lupus, trauma, malignancy, enzyme breakdown, deposition (gout or sarcoidosis) or erythema nodosum



CONSEQUENCES

Consequences

- Altered hemodynamics
- Altered thermoregulation
- Metabolic abnormalities
- Fluid and electrolyte imbalance
- Loss of nutrients
- Altered immune function
- Infection

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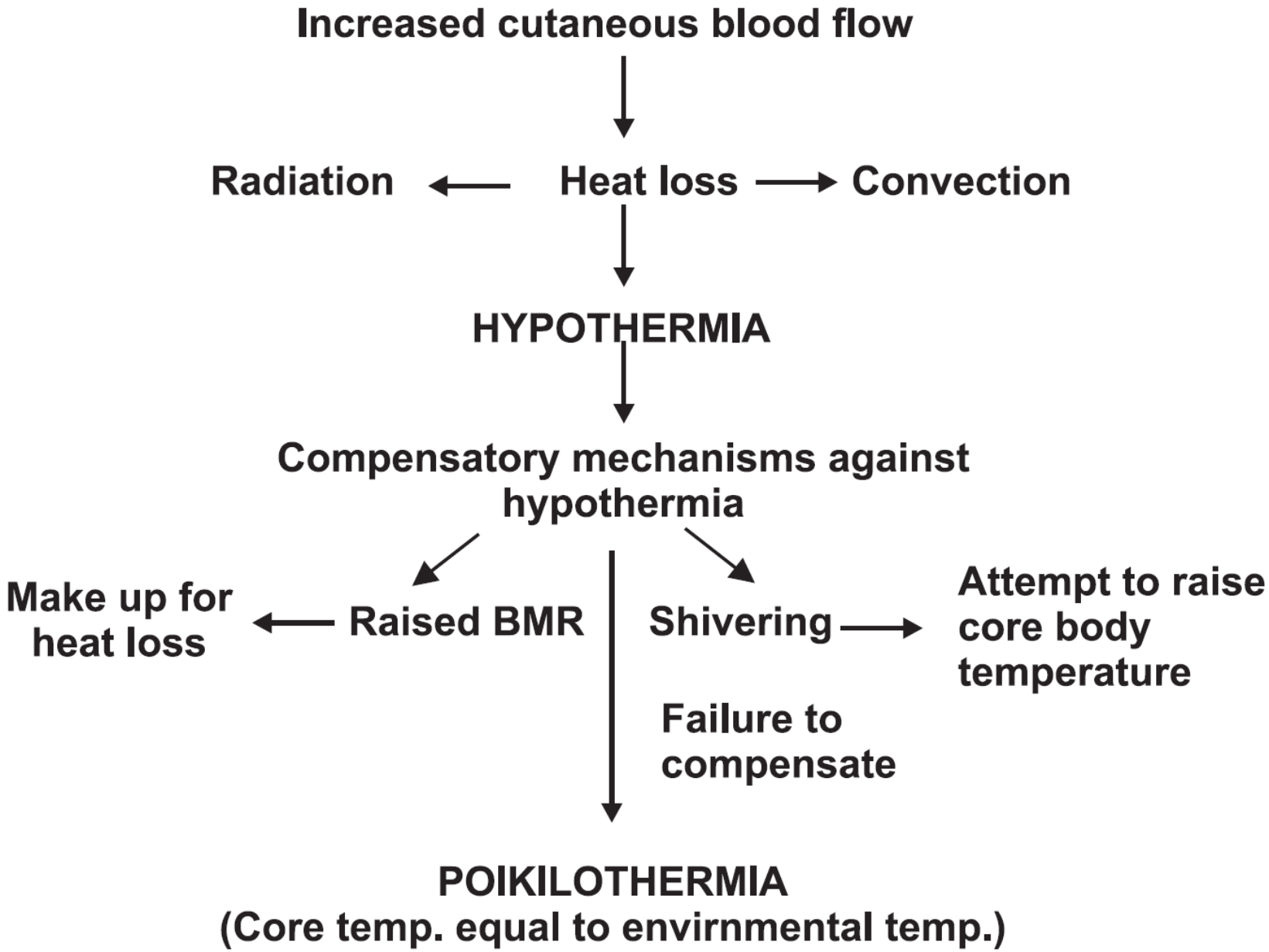

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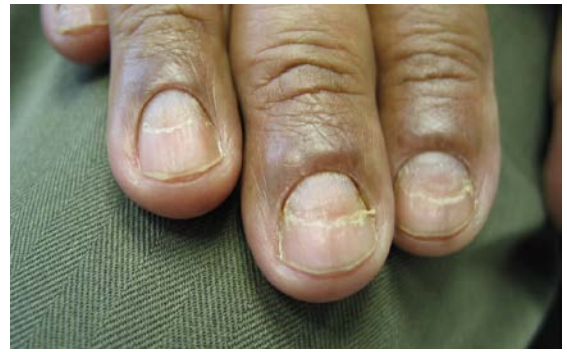
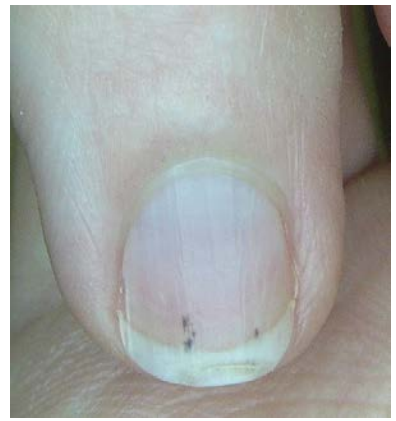
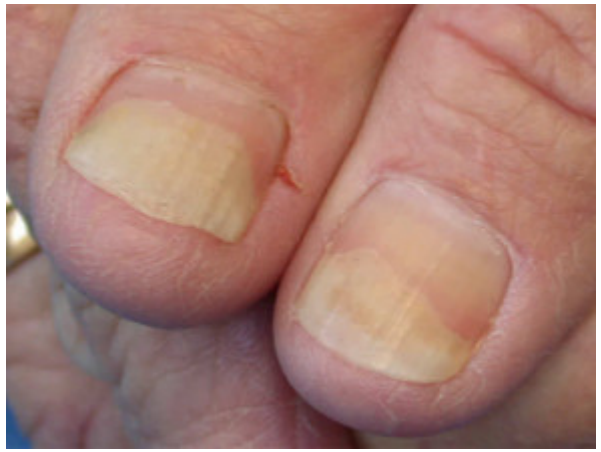
Table 2: Long-term complications of acute skin failure[15]

No.	Organ involved	Complications
1.	Eye	Ectropion, entropion, corneal scarring, symblepharon, secondary sicca syndrome
2.	Mucosal involvement:	
	Esophagus	Dysphagia resulting from stricture
	Urethra	Stricture and phimosis
	Vagina	Synechiae
3.	Skin	Pigmentary changes (hypo- and hyperpigmentation), hypohidrosis, contracture
4.	Hair	Scarring alopecia
5.	Nail	Beau's lines, splinter hemorrhage, distal onycholysis, dystrophy and total shedding of nails







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CARE

Consequences & Care

V/S, I/O

Blood chemistry

Altered hemodynamics

Altered thermoregulation

Metabolic abnormalities

Fluid and electrolyte imbalance

Loss of nutrients

Altered immune function

Infection

High prot. Diet 3g/kg/d

CBC, Consciousness, Culture

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Care

Topical management

Sedative

Ophthalmic care

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Table 4: Fluid, electrolyte replacement and nutrition in patients with acute skin failure[6], [7]

	Intravenous fluid	Nasogastric feeding
Initial 24 hours	Human albumin (diluted in normal saline, 40g/L), 1 ml/kg body weight per % BSA, + Normal saline 0.7 ml/kg body weight per % BSA,	1500-2000 ml (providing 1500-2000 calories)
Thereafter	To be guided by previous day's output. Gradual decrease of IV fluid	Progressive increase of nasogastric/oral supplementation. Increase by 500 cal/day, up to3500-4000 cal/day
Electrolytes	Supplementation of potassium phosphate in initial 24 hours	
Hypokalemia (alkalosis ruled out)	Inj. Potassium chloride (40 mmol/L) in 5% dextrose -saline/5% dextrose/NS, 6-8 hourly	Milk, fruit juice, honey. Potassium chloride syrup
Hyponatremia	NS (500 ml/day) supply normal daily requirement.Further deficit can be replaced by extra amount of NS	

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Poor prognosis factors

- Older age
- Larger BSA
- Severe neutropenia
- Early thrombocytopenia
- High BUN
- Long half-life in drug-induced cases

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Key points

Patients with extensive skin lesions may be febrile even w/o infection.

Sudden onset hypothermia in a relatively stabilized patient may be a premonitory sign of septic shock.

PR > 120/min, even in presence of precipitating factors like septicemia and fever indicates a negative fluid balance.

Inc. RR may be the first sign of hypoxia. (from pneumonia/pulmonary edema)

Low urine volume may be an early indicator of hypovolemia or septicemia.

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Key points

An altered sensorium, in the form of anxiety or confusion may be the first sign of sepsis.

If residual gastric aspirate volume>50 ml, periodic feeding is to be withheld.

Overzealous fluid correction may precipitate high output HF in patients with compromised cardiovascular system or may give rise to pulmonary edema.

Though serum concentration represents a normal value, occult hypokalemia may exist.

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CONCLUSION

Acute skin failure is a part of dermatological emergency.

Prompt diagnosis
Multidisciplinary, intensive care approach

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