

# Wound Healing in Older Adults

LISA J. GOULD, MD, PhD, FACS; ANA TUYA FULTON, MD, FACP

## ABSTRACT

Impaired wound healing in the elderly represents a major clinical problem that is growing as our population ages. Wound healing is affected by age and by co-morbid conditions, particularly diabetes and obesity. This is particularly important in Rhode Island as the state has a very high percentage of vulnerable older adults. A multi-disciplinary approach that incorporates the skills of a comprehensive wound center with specialized nursing, geriatric medicine and palliative care will facilitate rapid wound healing, reduce costs and improve outcomes for our older adults that suffer from 'problem wounds'.

**KEYWORDS:** wound healing, diabetes, obesity, aging

## BACKGROUND

Wound healing is a complex process that can be de-railed by multiple factors including obesity, diabetes, smoking, vascular disease, infection, renal failure and malnutrition. The current incidence of chronic non-healing cutaneous wounds is estimated at 5-7 million in the United States, with total annual wound care expenditures exceeding \$25 billion.<sup>1</sup> We are now entering a 'perfect storm' in which there is rapid expansion of the population over 65 years of age, combined with an exponential increase in diabetes and obesity worldwide. The fastest growing segment of this population, those over 85 years of age, is also the cohort with the highest incidence of chronic wounds, particularly venous leg ulcers and pressure ulcers.<sup>2-4</sup> Meanwhile, older adults have significantly higher rates of surgical procedures, with increased potential for wound complications.<sup>5</sup> The full impact of caring for chronic wounds includes direct costs (wound care supplies, hospital and nursing costs), indirect costs (lost wages for patient or caregiver) and intangible costs (pain and suffering). Thus, in addition to the effect on morbidity and mortality, we can expect that chronic wounds in the elderly will account for a disproportionate share of our nation's healthcare expenditures.

## PATHOPHYSIOLOGY

The healthy octogenarian with a traumatic or surgical wound normally heals at a slower rate than a healthy young adult. This effect of "pure aging" is clinically apparent by age 60 and becomes statistically significant at age 70.<sup>6</sup> However, because wound healing is a complex, highly orchestrated process, disruption of even a single aspect can delay

healing.<sup>7</sup> The development of chronic wounds is multifactorial and depends upon both intrinsic and extrinsic factors. The four principle aging processes are changes in body composition, energy imbalance, homeostatic disequilibrium and neurodegeneration. These 'intrinsic' factors can have a major effect on wound healing. Specifically, alteration of the skin architecture with loss of elasticity, thinning of the dermis and reduced capacity of keratinocytes to proliferate and migrate, make the skin vulnerable to even minor trauma. A recent study using an ex-vivo model demonstrated that application of a compressive load to ischemic aged skin resulted in sub-epidermal separation and altered orientation of the collagen fibers similar to that seen in patients with pressure ulcers.<sup>8</sup> Other changes in body composition include an increase in fat mass (FM) and decline in fat-free mass (FFM). Healthy, weight-stable men and women, between the ages of 68 and 78, lose approximately 1% of FFM per year. This loss of lean muscle translates to a 3-fold loss of strength and is a primary predictor of disability.<sup>9</sup> Age-induced dysregulation of energy intake and utilization is brought about through a combination of reduced perception of hunger, early satiety, changes in the hormonal mediators associated with energy balance and reduced energy expenditure.<sup>10</sup> The net effect in terms of weight gain or loss depends on a number of factors, including the overall health of the individual. However, all aspects of wound healing increase protein and energy requirements. In an elderly person who is already at high risk for malnutrition, the presence of a wound can tip the balance toward involuntary weight loss, development of sarcopenia, impaired immunity and increased risk of infection.<sup>11</sup> Sarcopenia, reduced functional ability and malnutrition, combined with the inability of aged skin to distribute a pressure load substantially increases the vulnerability of older adults to developing pressure ulcers.

Alterations in the homeostatic balance include increased pro-inflammatory markers, decreased antioxidants, decreased anabolic hormones, increased catabolic hormones and insulin resistance. All of these factors contribute to impaired wound healing and affect the skin's ability to function as an immune organ. Finally, neurodegeneration combined with impaired cognition, gait imbalance and slow reaction times contribute to immobility and decreased ability for self-care.<sup>12</sup>

## RISK FACTORS & CO-MORBIDITY

While intrinsic factors clearly increase the risk for developing wounds, the most vulnerable patients are those with multiple concurrent illnesses. Data from the U.S. Wound Registry indicate that patients in outpatient wound centers

have an average of six comorbid conditions, including a high prevalence of renal failure, peripheral vascular disease, diabetes and malnutrition.<sup>13</sup> Multi-morbidity, defined by the National Quality Forum as “two or more chronic conditions that collectively have an adverse effect on health status, function, or quality of life” is known to be associated with an increased risk of death and disability. The complexity of these wound care patients is made evident by considering that only 14% of Medicare beneficiaries have 6 or more chronic conditions.<sup>14</sup>

Obesity, defined as body mass index greater than 30, is a major public health problem that is not included in the indices of multi-morbidity. The incidence of obesity in the United States increased dramatically between 1980 and 2008, doubling for adults and tripling for children.<sup>15</sup> Although not often thought of as being a problem of aging, the startling reality is that more than one third of adults over the age of 65 are obese. What is concerning is that between 1990 and 2010 there has been a linear increase in the prevalence of obesity in older men. Thus, the prevalence of obesity has increased from 31.6% to 41.5% among men aged 65-74, while the prevalence among men 75 and older has increased from 17.7% to 26.5%.<sup>16</sup> In Rhode Island the prevalence of obesity among adults aged 65 and older has increased from 22.2% to 26.8% in 2 years, a rate of 21% (August 2015, retrieved from <http://www.americashealthrankings.org/Senior/RI#sthash.znb3kS7a.dpuf>). This alarming trend comes at great cost, with a health burden that includes an increased risk of diabetes, cardiovascular disease, osteoarthritis, stroke and cancer, all co-morbidities that impact wound healing.<sup>17</sup> Furthermore, obesity increases the risk of some of the most difficult wound healing problems: lymphedema and venous insufficiency.<sup>18,19</sup> Presenting with chronically erythematous, edematous and weepy legs, these patients are often admitted to the hospital for treatment of ‘cellulitis’ and account for approximately 50% of visits to outpatient wound centers. Because bilateral lower extremity erythema and edema is more likely to be related to an exacerbation of congestive heart failure than acute infection, treatment requires a multidisciplinary approach, particularly in older adults who are at high risk for complications from repetitive antibiotic administration, fluid overload and progressive disability. Older adults who are obese are also at risk for sarcopenia as fat replaces muscle mass. Intake of a calorically dense diet with increased carbohydrates and fat at the expense of protein, vitamins and minerals, paradoxically puts obese individuals at high risk for malnutrition. Involuntary weight loss occurs disproportionately in older obese individuals and is associated with high mortality.<sup>10</sup>

Diabetes is one of the most common co-morbidities among people presenting to wound clinics. As our population lives longer and grows heavier, the prevalence of type 2 diabetes is steadily increasing. Current estimates are that over one quarter of individuals over the age of 65 are diabetic. (*National Diabetes Statistics Report: Estimates of Diabetes and Its Burden in the United States, 2014*) Although the risk of type 2 diabetes is increased by obesity, both insulin resistance and reduced pancreatic islet cell function are age-related changes that can result in diabetes in older adults of normal weight.<sup>20</sup> Diabetes accelerates the normal rate of

aging in a wide variety of physiological processes. Diabetes management is more complex in the older adult with multiple co-morbidities, impaired nutrition, polypharmacy and functional disabilities. The combination of peripheral neuropathy and peripheral vascular disease greatly increases the risk of wound healing complications, foot ulcers and lower extremity amputations in the elderly patient with diabetes. Co-existing visual impairment and impaired cognitive function may lead to delayed presentation with greater severity and more difficult management. The good news is that the rate of hospital admissions for diabetics with lower extremity amputation and ulcers declined between 1988 and 2007. Although the discharge rate in 2007 for lower extremity condition (peripheral arterial disease, ulcer/inflammation/infection, and neuropathy) as the first-listed diagnosis among diabetics aged 75 years or older was 21.6%, the rate has been steadily declining ([www.cdc.gov](http://www.cdc.gov)). The rate of non-traumatic lower extremity amputation in diabetics has steadily declined since 1996, particularly for those over 75 (dropping from 19.4% in 1996 to 3.7% in 2009). One interpretation is that outpatient care is improving, preventing the necessity of hospital admission.

## DISCUSSION & CLINICAL IMPLICATIONS

From the foregoing discussion it should be clear that care of the patient with chronic wounds requires a multidisciplinary approach and that this is even more critical in the elderly patient. Many of these wounds require specialty care that is beyond the scope of what the primary care physician can provide. Specialized wound centers have been developed to facilitate healing of the most difficult wounds and need to be prepared to manage the complexities of the elderly patient. Additionally, providers trained in geriatrics and palliative care are often involved in the care of these complicated patients to assist with symptom management, goals of care clarification, and to prevent functional decline, polypharmacy and to maximize quality of life. In Rhode Island this is particularly important as the state ranks 8<sup>th</sup> nationally in percentage of people over 65 and 4<sup>th</sup> in those age 70 and older. (2006 US Census) In 2013, 59% of patients treated at the Kent Hospital Wound Recovery Center were at least 65 years old and 28% were over the age of 80. The goal of the comprehensive wound center is to promote wound healing through evidence-based protocols. An early and aggressive approach to wound closure reduces cost, improves quality of life and prevents re-admission to the hospital. The wound care clinician will assist with the diagnosis, provide appropriate debridement to remove necrotic tissue and prescribe treatments that move the wound towards bacterial balance and promote healing.

However, older adults have additional special needs that merit multidisciplinary care and comprehensive assessment. According to the US Census Bureau, 20% of people over age 65 have some chronic disability with 8% having significant cognitive impairment and 30% having difficulty with mobility. More than 40% of individuals over the age of 85 living in the community have difficulty performing activities of daily living and 1 in 6 report cognitive limitations (Rising demand for long-term services and supports for elderly people, 2013.

www.cbo.gov/publications/4240. Retrieved August 18, 2015). Some older adults with wounds require more emphasis on palliation with control of symptoms and avoidance of infectious complications. Interestingly, more than 50% of wounds treated with a palliative approach ultimately heal.<sup>21</sup> Wound specialists have an in-depth knowledge of and access to advanced wound care modalities that promote healing, reduce odor and increase comfort. The multidisciplinary approach emphasizes optimization of medical management, nutrition, mobility, pressure reduction, and perfusion while exploring barriers to care. For the elderly patient these barriers may include financial stress and lack of social support. Furthermore, best practice, evidence-based wound healing modalities such as diabetic foot off-loading and compression wrapping need to be modified for the elderly patient with gait disturbances, risk of falls or congestive heart failure. Teamwork is critical to facilitate care across the continuum and requires coordination with the family, with home health services and with the primary care physician.

The \$5 billion global market for 'advanced wound management' is expected to triple in the next ten years. Our nation's older adults will receive a disproportionate share of this advanced care. Because of the high proportion of older adults in Rhode Island we are positioned to be leaders in the development of evidence-based wound care protocols that focus on the special needs of the geriatric patient, decrease cost, reduce the need for admission to the hospital and improve outcomes.

## References

- Sen, C.K., Gordillo, G.M., Roy, S., Kirsner, R., Lambert, L., Hunt, T.K., Gottrup, F., Gurtner, G.C., Longaker, M.T. Human skin wounds: A major and snowballing threat to public health and the economy. *Wound Repair Regen.* 2009; 17(6):763-771. doi:10.1111/j.1524-475X.2009.00543.x
- Margolis, D. The Incidence and Prevalence of Pressure Ulcers among Elderly Patients in General Medical Practice. *Ann. Epidemiol.* 2002;12(5):321-325. doi:10.1016/S1047-2797(01)00255-1
- Margolis, D.J., Bilker, W., Santanna, J., Baumgarten, M. Venous leg ulcer: incidence and prevalence in the elderly. *J. Am. Acad. Dermatol.* 2002; 46(3):381-386.
- Ortman, J., Velkoff, V., Hogan, H. An Aging Nation: The Older Population in the United States, Current Population Reports. 2014; US Census Bureau, Washington, DC.
- DeFrances, C.J., Lucas, C.A., Buie, V.C., Golosinskiy, A. 2006 National Hospital Discharge Survey. *Natl. Health Stat. Rep.* 2008; (5):1-20.
- Wicke, C., Bachinger, A., Coerper, S., Beckert, S., Witte, M.B., Königsrainer, A. Aging influences wound healing in patients with chronic lower extremity wounds treated in a specialized wound care center. *Wound Repair Regen.* 2009;17(1):25-33. doi:10.1111/j.1524-475X.2008.00438.x
- Gouin, J.-P., Hantsoo, L., Kiecolt-Glaser, J.K. Immune Dysregulation and Chronic Stress among Older Adults: A Review. *Neuroimmunomodulation.* 2008;15(4-6):251-259. doi:10.1159/000156468
- Stojadinovic, O., Minkiewicz, J., Sawaya, A., Bourne, J.W., Torzilli, P., de Rivero Vaccari, J.P., Dietrich, W.D., Keane, R.W., Tomic-Canic, M. Deep Tissue Injury in Development of Pressure Ulcers: A Decrease of Inflammation Activation and Changes in Human Skin Morphology in Response to Aging and Mechanical Load. *PLoS ONE.* 2013;8(8):e69223. doi:10.1371/journal.pone.0069223
- Fantin, F., Di Francesco, V., Fontana, G., Zivelonghi, A., Bissoli, L., Zoico, E., Rossi, A., Micciolo, R., Bosello, O., Zamboni, M., 2007. Longitudinal body composition changes in old men and women: interrelationships with worsening disability. *J. Gerontol. A. Biol. Sci. Med. Sci.* 62, 1375-1381.
- Roberts, S.B., Rosenberg, I. Nutrition and Aging: Changes in the Regulation of Energy Metabolism With Aging. *Physiol. Rev.* 2006;86(2):651-667. doi:10.1152/physrev.00019.2005
- Demling, R.H., 2009. Nutrition, anabolism, and the wound healing process: an overview. *Eplasty* 9, e9.
- Grimby, G., Danneskiold-Samsøe, B., Hvid, K., Saltin, B. Morphology and enzymatic capacity in arm and leg muscles in 78-81 year old men and women. *Acta Physiol. Scand.* 1982;115(1):125-134. doi:10.1111/j.1748-1716.1982.tb07054.x
- Horn, S.D., Fife, C.E., Smout, R.J., Barrett, R.S., Thomson, B. Development of a wound healing index for patients with chronic wounds. *Wound Repair Regen.* 2013; 21(6): 823-832. doi:10.1111/wrr.12107
- Centers for Medicare and Medicaid Services. Chronic Conditions Among Medicare Beneficiaries, Chartbook, 2012 Edition. Baltimore, MD: Centers for Medicare and Medicaid Services; 2011. (<http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/ChronicConditions/CCChartBook.html>). (Accessed Sept 30 2015).
- Ogden, C.L., Carroll, M.D., Kit, B.K., Flegal, K.M. Prevalence of Childhood and Adult Obesity in the United States, 2011-2012. *JAMA.* 2014;311(8):806. doi:10.1001/jama.2014.732
- Fakhouri, T.H.I., Ogden, C.L., Carroll, M.D., Kit, B.K., Flegal, K.M. Prevalence of obesity among older adults in the United States, 2007-2010. *NCHS Data Brief.* 2012; (106):1-8.
- Wang, Y.C., McPherson, K., Marsh, T., Gortmaker, S.L., Brown, M. Health and economic burden of the projected obesity trends in the USA and the UK. *The Lancet.* 2011; 378(9793):815-825. doi:10.1016/S0140-6736(11)60814-3
- Mehrara, B.J., Greene, A.K. Lymphedema and Obesity: Is There a Link? *Plast. Reconstr. Surg.* 2014;134,(1):154e-160e. doi:10.1097/PRS.0000000000000268
- Vines, L., Gemayel, G., Christenson, J.T. The relationship between increased body mass index and primary venous disease severity and concomitant deep primary venous reflux. *J. Vasc. Surg. Venous Lymphat. Disord.* 2013;1(3): 239-244. doi:10.1016/j.jvsv.2012.10.057
- Halter, J.B. Diabetes Mellitus in an Aging Population: The Challenge Ahead. *J. Gerontol. A. Biol. Sci. Med. Sci.* 2012;67(12):1297-1299. doi:10.1093/gerona/gls201
- Alvarez, O.M., Kalinski, C., Nusbaum, J., Hernandez, L., Pappous, E., Kyriannis, C., Parker, R., Chrzanowski, G., Comfort, C.P. Incorporating wound healing strategies to improve palliation (symptom management) in patients with chronic wounds. *J. Palliat. Med.* 2007; 10(5):1161-1189. doi:10.1089/jpm.2007.9909

## Authors

Lisa J. Gould, MD, PhD, FACS, Medical Director, Kent Hospital Wound Recovery and Hyperbaric Medicine Center

Ana Tuya Fulton, MD, FACP, Director of Geriatric Medicine, Care New England; Chief of Internal Medicine, Butler Hospital; Associate Professor of Medicine (Clinical) and Associate Professor of Psychiatry and Human Behavior (Clinical), The Warren Alpert Medical School of Brown University

## Correspondence

Lisa J. Gould, MD, PhD, FACS  
Medical Director  
Kent Hospital Wound Recovery  
and Hyperbaric Medicine Center  
455 Tollgate Rd  
Warwick, RI 02886  
401-736-4646  
Fax 401-736-4248  
[ljgould@kentri.org](mailto:ljgould@kentri.org)

Ana Tuya Fulton, MD, FACP  
345 Blackstone Blvd  
Center House Rear 211  
Providence RI 02906  
401-680-4128/401-455-6362  
Fax 401-680-4288  
[afulton@butler.org](mailto:afulton@butler.org)