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"Geriatric Trauma: Out with the Young, In with the Old"

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Abstract

Elderly patients represent a rapidly growing segment of the world's population, and require special considerations in the management of trauma related injuries. This paper will outline the epidemiology of aging, provide a foundation for understanding the physiology of aging and frailty, discuss evidence-based outcomes related to specific examples in geriatric trauma, and conclude with an overview of the institutional experience with geriatric trauma, including new initiatives at Westchester Medical Center/New York Medical College in Valhalla, NY.

Trauma has evolved as a field from the care of penetrating injuries in the young, to blunt injury in the elderly. The proportion of elderly persons at large, and geriatric trauma patients, is continuing to increase locally, nationally, and worldwide. The physiologic decline associated with aging involves multiple physiologic systems both on an organ-system and cellular level, and can be better assessed with tools such as frailty, which, in turn, can be used for appropriate risk assessment and resource utilization in treating geriatric patients. Trauma-related pathologies such as traumatic brain injury, blunt thoracic trauma, and orthopedic injuries are potentially life-threatening pathologies and are associated with a significant risk for increased morbidity and mortality. Emphasis on geriatric trauma has been promulgated by several organizations including the American College of Surgeons. The systems used for the designation and accreditation of trauma centers in the United States are useful in validating the benefits of specialized care for the geriatric trauma patient. In addition to evidence-based multidisciplinary management, the care of geriatric trauma patients involves a shared decision-making model where communication with patients and their families must take into account palliative considerations, including quality of life and overall goals of care.

The Westchester Medical Center experience in geriatric trauma has focused on patient-specific and institutional initiatives resulting in forward-thinking protocols, interdisciplinary collaboration, and novel patient-care related and research initiatives.

Keywords: Geriatric trauma, patient-specific, institutional initiatives, forward-thinking protocols

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Introduction

The number and proportion of elderly individuals (≥ 65 years of age) is continuing to increase worldwide. In the United States, this growth, in both number and proportion, is unprecedented. Given that the geriatric population has become increasingly active, thanks to increasing life spans owing to modern medicine and cultural evolution, trauma in the elderly continues to increase in volume.[1] In the span of a decade, between 2008 and 2017, unintentional injury (or trauma) has increased in its relative contribution as the leading cause of death amongst this geriatric population in the United States.[2] At Westchester Medical Center, a regional tertiary care hospital, and American College of Surgeons, a verified Level 1 trauma center, the data is similarly striking with respect to the sustained increase in total geriatric trauma admissions over the past five years. Although the mechanisms of geriatric trauma are predominantly blunt in nature, when compared to younger patient populations, the physiologic changes associated with aging place the geriatric trauma patient at a significantly increased risk for poor outcomes and mortality, particularly, when superimposed upon the common syndrome of frailty.[3] Due to both physiologic and injury-related special considerations in geriatric trauma, surgical decision-making is inherently more complex when compared to the care of the younger trauma patient, and often requires a more definitive approach early in the assessment and management in order to account for the lack of physiologic reserve.[4] However, special consideration must be given as well to patient autonomy and quality of life by using a shared decision-making model that is patient centric and includes the wishes of the patient, the involvement of patients' families, and the judgment of the clinical provider. Therefore, an understanding of the epidemiology and physiology of aging, the concept of frailty, and data related to outcomes in geriatric trauma are of utmost importance in prioritizing the needs of this vulnerable patient population, so that outcomes can be improved through a multidisciplinary, innovative approach on clinical and systems-based levels.

The Physiology of Aging, Outcomes for Specific Injury Patterns, and Impact of Frailty

The physiologic changes associated with aging occur on both a cellular and organ system basis. They are extensive in their reach. With respect to the cardiovascular system, the aging process is naturally accompanied by an increased overall prevalence of cardiac comorbidities. There are several anatomic changes such as the replacement of cardiac myocytes with fat and fibrous tissue and progressive atherosclerotic changes that lead to an increased afterload. Due to such physiologic changes, it is important to recognize that traditional vital sign thresholds do not accurately correlate with the physiology of shock in the elderly trauma patient.[5] Similarly, there are significant effects of aging upon pulmonary physiology. Reduced muscle mass and decreased elastic recoil of the lung cause a decrease in the functional residual capacity and gas exchange, creating for less pulmonary reserve.[6] At the same time, the age-related loss of bone density lends itself to an increased risk of rib fractures, and the progressive decline in mucociliary reflexes increases the risk for aspiration in the elderly patient. Additionally, the gastrointestinal system diminishes in function during the natural aging process as significant nutritional imbalances and decreased appetite place the geriatric patient at increased risk for an attenuated response to physiologic stressors.[7]

Taken together, these manifestations of impaired and deteriorating physiology not only place the elderly trauma patient at risk for poor outcomes, but also obfuscate the initial assessment and triage of the geriatric trauma patient where traditional parameters for assessing neurologic function and vital signs may be wholly inaccurate due to confounding variables. The outcomes of geriatric trauma patients with respect to specific injury patterns has been the subject of investigation for several years, and continues to be an area of interest. In 2002, Susman et al. demonstrated that elderly patients suffering traumatic brain injury across all major categories of Glasgow Coma Score have increased rates of mortality and poor functional outcome despite lower injury severity, when compared to their younger counterparts.[8] Similarly, it was shown two decades ago that elderly patients sustaining rib fractures have a significantly increased risk of both mortality and pulmonary

complications when compared to younger patients with similar injuries.[9]

Whereas the physiology of aging is well understood, it has become important to consider that there is significant heterogeneity in the geriatric population with respect to comorbidity, functional dependence, and overall physiologic reserve. This heterogeneity has led to the development and study of measures of such "vulnerability" distinct for age, such as frailty. Frailty is defined by both intrinsic and extrinsic factors (biologic and psychosocial), and is an entity that is related to, but independent from, age.[10] Given that there is no generally agreed upon definition of frailty, there are a number of available indices for measurement and quantification. Though the predictive value of these various indices is of significant academic interest, its practical applications to clinical settings becomes increasingly important when accounting for the sustained increase in elderly individuals in the general population. Particularly in trauma, where optimization of modifiable components of frailty is not feasible prior to intervention or delivery of care, frailty has become an important tool for risk stratification and resource utilization. To this end, a trauma specific frailty index (TSFI) has been developed and validated in prospective studies as an accurate tool to predict outcomes in the geriatric trauma population.[11]

Research Studies from Westchester Medical Center in Geriatric Trauma

The clinical and research missions of the Department of Surgery at Westchester Medical Center (WMC) are intertwined to promote academic pursuits that have a direct impact upon patient care. A research study was undertaken to analyze the impact of frailty on outcomes of geriatric trauma patients, admitted to the intensive care unit in order to investigate the effects upon clinical outcomes and resource utilization. This study demonstrated that frail geriatric trauma patients had higher rates of resource utilization, such as length of stay and duration of mechanical ventilation, as well as increased rates of complications and overall mortality. This study underscores the impact of frailty upon the most critically ill geriatric trauma patients. Similarly, the Department of Surgery at WMC used a large national trauma database to study the predictors of mortality after craniotomy amongst geriatric trauma patients with severe traumatic brain injury, given that outcomes are known to be worse in this patient population. This study was presented at the 2020 Meeting of the American Association for the Surgery of Trauma and used multivariable regression analysis to identify risk factors for in-hospital mortality amongst patients greater than 65 years of age with isolated severe traumatic brain injury undergoing craniotomy. Age greater than 84, frailty, the presence of two or more concomitant foci of intracranial hemorrhage and pre-hospital use of anticoagulant medications were found to be independently associated with higher mortality amongst this patient population. Given that one out of every four patients included in this study died, it was concluded that a more precise risk stratification for outcomes could lead to an enhanced decision-making process for both providers and patients.

Over the past several years, based on a vast body of peer-reviewed studies, the American College of Surgeons (ACS) has promulgated a national focus on geriatric trauma for trauma centers seeking the various levels of verification by the Committee on Trauma of the ACS. Given this emphasis on geriatric trauma on a national systems-based level, the Department of Surgery at WMC sought to study the impact of trauma center designation (by the ACS) upon outcomes in geriatric trauma. This work was presented at the 2020 Annual Congress of the American College of Surgeons and demonstrated that geriatric trauma patients admitted to an ACS verified Level 1 (highest designation) trauma center had lower rates of mortality and complications such as acute kidney injury and acute respiratory distress syndrome with higher rates of favorable discharge dispositions, despite these patients being more severely injured. The data suggests that the verification system used by the American College of Surgeons, and the associated high standards used for verification, do impact patient outcomes in the elderly by creating a systems-based emphasis on quality.

Geriatric Trauma: The Westchester Medical Center Experience

As an ACS verified level 1 trauma center, Westchester Medical Center has seen a sustained increase in the number of geriatric trauma admissions

over the past several years. Taken together with the available body of literature and evidence supporting the need for increased vigilance and focused multidisciplinary measures to care for the geriatric trauma patient, our trauma center has undertaken a number of initiatives designed to advance the care provided to this patient population. Given that the care of trauma patients begins with patient triage, we have worked in a multidisciplinary fashion with nursing and other medical subspecialties to broaden the scope of our trauma triage criteria. The goal of any institution's trauma triage criteria is to ensure that a safety net is in place to provide timely, intensive, and resource-rich attention and care to patients with trauma-related injuries and mechanisms in order to maximize the level of attention and detail. As each institution generally creates its own guidelines for establishing the triage criteria, the Westchester Medical Center recently sought to pay particular attention to the triage of geriatric trauma patients. Given that geriatric trauma patients have less physiologic reserve and population-specific concerns (such as the increased prevalence of pre-hospital anticoagulant use), the trauma activation (triage)criteria were modified to include age ≥ 65 years, as well as pre-hospital anticoagulant use, as specific criteria to warrant the highest levels of trauma activation. By doing so, our trauma center has taken steps to ensure that the geriatric trauma patients are approached with greater vigilance and expedience with all of the available expertise and resources needed to proactively care for this high-risk patient population. In addition, the WMC trauma center has created an entirely separate trauma activation process where patients who do not meet the revised institutionally established criteria for high level trauma system activation, but deemed by any provider to be at risk for poor outcomes (i.e. elderly), will automatically be activated into a pathway that expedites all aspects of their clinical evaluation and treatment. This proactive evidence-based approach is an example of the multidisciplinary effort required on an institutional level to ensure that geriatric trauma patients are given the best possible chance for favorable outcomes by emphasizing interdisciplinary teamwork, vigilance, and resource utilization.

Falls and fall-related injuries in the geriatric population have been a topic of discussion for many years, as evidenced by coverage of the issue in several non-medical forums such as newspapers, periodicals, and live media coverage. Data from the United States Centers for Disease Control demonstrates a concerning trend of increasing rate of geriatric fall-related deaths in the past two decades. Moreover, this same national repository of data shows that for those geriatric patients that survive their fall-related injuries, the overall economic impact is enormous as there are significant medical costs in addition to the impact of lost wages. As such, falls in patients aged ≥ 65 represent a significant public health burden. The injuries sustained as a result of falls vary in severity but are often significant, and include traumatic brain injuries, fractures, and lacerations.[12] The factors that predispose the elderly to falls are multifactorial in nature, related to both intrinsic factors, such as comorbidity and frailty, as well as extrinsic factors, such as polypharmacy and environmental hazards. However, several studies have shown that, regardless of the initial predisposing factors, falls trigger a cycle of immobility, functional and cognitive decline, functional dependence, repeat falls and hospitalizations, and increased risk for mortality.[13,14]

Our data from the registry of the WMC trauma program shows that the overwhelming majority of our geriatric trauma is due to blunt mechanisms, and, further, that a significant percentage of these patients are admitted due to fall-related injuries. In fact, retrospective analysis shows that the number of geriatric trauma patients with fall-related injuries requiring hospital admission has been steadily increasing over the past five years. As stated previously, the impact of these falls and their associated injuries is significant with respect to both mortality and quality of life. In our experience, geriatric patients admitted with fall-related injuries have a mortality rate between 7 and 9% which, although overall low, is considerable in terms of the number of lives lost. More importantly, our trauma registry data demonstrates that more than 40% of these patients are discharged to settings of lower functional independence compared to their original residence, indicating a tremendously adverse impact upon the quality of life.

Whereas fall prevention is an established priority on institutional, societal, and governmental levels, most initiatives and interventions aimed at reducing the incidence of falls are predominantly aimed towards preventing primary falls amongst community residents. Unfortunately, there is less of a focus on preventing

recurrent falls amongst geriatric patients admitted after fall-related injuries, since the primary goal for such patients, on both provider and institutional levels, is to provide treatment and care for the injuries sustained. Nonetheless, it is important to note that recidivism, or recurrent falls, represents an entity that warrants considerable attention. Both studies of nursing home residents and single institution studies have demonstrated that up to 40% of nursing home residents fall more than twice per year, and that recurrent falls result in an increased mortality and socioeconomic burden.[15,16] Identifying the risk factors for recurrent falls, as well as the impact on clinical outcomes on a broader (national and international) scale is important., There is a relative paucity of data. iTo this end, the trauma center of WMC conducted a study using a large national database of hospital readmissions. It was able to demonstrate that specific comorbidities portend a stronger risk for repeated hospital admissions, due to fall-related injuries, and that geriatric patients that are hospitalized repeatedly for fall-related injuries have worse clinical outcomes.[17] Given that recurrent falls in the elderly represent a significant public health concern, the question is raised as to what steps, if any, are taken to intervene and prevent recurrent falls amongst geriatric patients, admitted to hospitals with fall-related injuries. A recent epidemiologic study, hypothetical in nature, estimated that referral of elderly patients with fall-related injuries to prevention programs prior to discharge from emergency departments could reduce recurrent falls and associated treatment costs.[18] Given that this was only a hypothetical study, our trauma center has asked the question of why it would not be feasible to institute such a program. As such, WMC has developed a prospective multidisciplinary team and program, designed to provide multifactorial intervention during the period of hospitalization and longitudinal follow-up for all geriatric trauma patients admitted with fall-related injuries. As part of this program, all admitted geriatric patients with fall-related injuries will be screened for fall-risk, provided with validated fall-prevention tools and referred for outpatient programs by an interdisciplinary team of physicians, nurses, physical therapists, pharmacists, occupational therapists, and injury prevention specialists. The families and primary care (community) physicians of these patients will be involved in these interventions through education and close communication regarding strategies to reduce fall recurrence, such as alterations in home environment, use of gait aids, and alterations in outpatient medication regimens. In addition, after discharge, all of these patients will have regularly scheduled in-person or telemedicine-based follow-ups for up to one year in order to encourage compliance with the suggested strategies and to assess success of the interventions. This approach is novel and innovative, but represents a multidisciplinary institutional initiative to address a public health concern that merits dedicated resources.

Conclusions

Given the increasing proportion of active elderly persons, trauma in the geriatric population is a locoregional epidemic and a worldwide pandemic. The physiology of aging, as it relates to function decline, occurs on both cellular and organ-system levels and results in impaired functional reserve and increased susceptibility to poor outcomes particularly in the setting of trauma. The assessment of functional reserve must take the concept of frailty into account, as validated measures of frailty have been shown to be useful in stratifying risk for poor outcomes. They, in turn, can be used to guide resource allocation. Westchester Medical Center continues to use its experience with increasing geriatric trauma volume to add to the scientific body of peer-reviewed literature, as well as to develop innovative multidisciplinary programs for improving outcomes in geriatric trauma. In order to improve outcomes in geriatric trauma, there must be a concerted effort to invest in resources, research, and collaboration on the part of individual institutions, agencies, and governments.

Conflict of Interest Disclosure Statement

The authors have no financial interests nor conflicts of interest to disclose.

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