Curr Surg Rep (2020) 8:18
https://doi.org/10.1007/s40137-020-00264-4

Geriatric Trauma Service: What is so Special?

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Published online: 25 June 2020

Abstract
Purpose of Review This is a review for the establishment and management of a geriatric trauma service. As our population ages, the geriatric trauma population increases. Our review shows these patients are unique and challenging in their medical management. We explain changes seen in trauma patients as we age. Undertriage of these patients should be specifically avoided.
Recent Findings Evidence supports the development of a specialized team and unit for managing the older trauma patients for improved outcomes. However, the evidence is lacking a true comparison on the most effective way to best stratify these patients into higher risk groups based on baseline status. Also, more evidence is needed to describe the post-discharge follow-up care needed for these patients.
Summary A geriatric trauma service will support the trauma center by improving data acquisition needed for research programs and promoting the continuous development of prevention programs that will cater to the needs of this population.

Keywords Geriatric trauma service · Frailty · Geriatric unit · Undertriage · Multidisciplinary team · Trauma activation

Introduction

One of the most considerable challenges that the trauma surgeon may encounter is the acute management of the geriatric patient. The population older than 60 years is exposed to specific medical-surgical situations that require a different approach in its management and treatment when compared to a younger adult population [1]. The geriatric population is increasing significantly worldwide. This group, in the USA, already constitutes more than 15% of the population with a projection that will increase to 20% in 2050 [2]. The increase in the geriatric population is also considerable in the European Union and Japan (17% and 23%) [2]. In Latin American countries, we see that this group of the population constitutes a much lower percentage (6–11%) [2]. However, the number of people over the age of 60 is increasing considerably not only in Central and South America, but in other regions such as Africa and Southeast Asia. Of this increase, worldwide, 66% occurred in these regions and the rest in the USA, Japan, and Europe. This trend is going to intensify over the next thirty years. In the more developed countries, the geriatric population will increase from 310 million in 2017 to 427 million in 2050. By contrast, the developing countries will see this population more than double during the same period, increasing from 652 million to 1.7 billion; almost 80% of the world's geriatric population will be found in these regions by 2050 [3].

Geriatric Trauma

Unintentional injuries are the seventh cause of death within the geriatric population in the USA [4]. In a study completed by a Level One trauma center over a 12-year period,

This article is part of the Topical Collection on *Trauma Surgery*.

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the percentage of geriatric trauma patients admitted to the institution increased from 13 to 27%. This was reflected in a prevalent increase of 67% in the actual number of total geriatric trauma admissions [5••]. The trauma surgeon must be prepared for the diagnosis, management, and treatment of the geriatric trauma patient. What is the difference between the management of geriatric trauma patients and a younger cohort of trauma patients? Factors to consider are pre-existing medical conditions, a compromised or diminished physiological reserve, a reduced daily functional capacity, possible deterioration in mental capacity, previous surgical interventions, multiple medications, domestic abuse, and different injury patterns. Unfamiliarity with the specific needs of this population by health care professionals create unique challenges in the management of this population [6]. For example, most of these patients take a wide-range of medications concomitantly. The most common ones are for high blood pressure control (55%), arrhythmias (26%), blood glucose control (22%), antiplatelets therapy (22%), and anticoagulation (10%) [7]. Trauma surgeons must have a suspicion that most of these patients do not provide correct or all the vital information necessary about their surgical or medical background. Also, the prevalence of pre-existing medical conditions increases considerably through the decades of life (17% in the 4th decade, 40% in the 6th decade, 80% in the 9th decade) [8]. These conditions predispose the patient to develop a partial or inadequate response to the stress of the trauma.

The acute management of the geriatric trauma patient presents specific considerations for the health professional. The injuries usually exhibit a multifactorial origin and it is necessary to consider any physiological disabilities, environmental hazards and behavioral changes related to the trauma of the patient. The area where these three conditions intercede reveals the group with the highest risk index for injury. The most common mechanism causing injuries in the geriatric trauma patient population is falls [9, 10]. Between 65 to 70% of admissions to a trauma center by this population are due to falls [11]. Geriatric patients over 65 years of age have a 33% probability of suffering a fall, increasing to 50% after age 80 [12]. In addition, one-fifth of vehicle–pedestrian accident fatalities occur in victims over the age of 65 [13, 14]. Motor vehicle crashes are the second most common cause of admissions among this population (12–15%), followed by pedestrian trauma (10–12%), and penetrating/assault trauma (1.8%) [11, 15].

Pre-existing medical conditions are one of the biggest factors to consider in the management of geriatric patients [16]. For example, a study found that geriatric trauma patients with congestive heart failure showed an increase in mortality rate when compared to geriatric trauma patients without this medical condition. Furthermore, the risk is even higher (> 25% mortality rate) in those patients with congestive heart failure taking beta-blockers, warfarin and/or antiplatelets therapy [17]. Another study demonstrated that a group of patients with cardiopulmonary medical problems who suffered from rib fractures and/or pulmonary contusions had a mortality rate 10% higher than that of a similar group without these pre-existing conditions. The group demonstrating these conditions prior to trauma showed a much longer hospital stay (8.5 vs. 4.3 days) and a significant number of complications (77% vs. 19%) [18]. An example of the poor response from the geriatric population to thoracic trauma is a study showing that geriatric patients had an increase in mortality of 19% and a 27% increased risk of developing pneumonia for each additional fracture above two fractures. Adequate pain control reduced this mortality by 6% [19]. The geriatric patients with rib fractures and pulmonary contusions require constant monitoring, judicious use of intravenous fluids, adequate pain control, robust physical therapy, and an aggressive management of lung secretions. Admission to the intensive care unit (ICU) is highly recommended for best results [20, 21, 22•].

One of the primary considerations in the management of geriatric trauma patients is to appreciate that these patients present a higher risk of mortality and morbidity compared to the younger adult population with analogous injuries [23, 24••]. One study about patients with similar injury severity scores between the young adult and geriatric populations found that the geriatric population with mild and moderate injury severity scores (ISS) presented a fivefold increase in mortality and a fourfold increase with severe ISS (Table 1). Furthermore, the same occurs with morbidity within this population. The geriatric population presented a threefold increase between mild and moderate severity scores and a twofold increase between severe scores compared to the younger adult population (Table 1) [24••]. For this reason, geriatric trauma patients should be evaluated, diagnosed, and managed as soon as possible upon arrival to the emergency room even if they present with mild injuries. Undertriage should be avoided at all costs within this patient population [25, 26•]. Immediate intervention and resuscitation is imperative due to their pre-existing medical conditions and poor physiological reserve [27, 28•].

The initial evaluation of the geriatric patient requires a detailed history and physical examination. In many occasions, this initial evaluation can be extremely challenging due to the poor physical condition of the patient and any other sensory deficit which makes communication with the patient difficult. In addition, most of these patients arrive to the emergency room without a family member who can provide essential information about the patient. This becomes particularly important in patients presenting with

Table 1 Morbidity/s [24••]

Injury severity score	% Mortality		*p* value	% Morbidity		*p* value
	Age 13–60	Age > 60		Age 13–60	Age > 60	
Minor (0–9)	0.6	3.3	0.001	1.5	5.0	0.001
Major (10–15)	1.4	5.9	0.001	4.8	10.4	0.001
Severe (16–24)	4.3	12.0	0.001	10.9	16.4	0.001
Critical (> 24)	27.9	41.3	0.001	27.3	28.0	0.0495

a mild or moderate injury severity score where undertriage could easily transpire [29–31]. The medical care offered to the geriatric patient should be different from the care provided to the younger population with the same type of traumatic injuries [23, 24••]. The secondary and tertiary surveys for trauma evaluation need to be comprehensive in these patients [32]. Studies have shown that the detailed and meticulous care and monitoring of these patients reduce the risk of mortality by 4.2% [5••, 11]. A high degree of suspicion is necessary in the management of the geriatric trauma patient (Table 2).

Physiological Considerations

Geriatric trauma patients generally are prone to develop cardiac arrhythmias due to increased myocardial susceptibility to stress from the acute condition. Atrial fibrillation is a common arrhythmia that occurs de novo or is pre-existing at the time of the trauma. The respiratory reserve of this population is significantly decreased, especially in patients with a history of smoking. The use of supplemental oxygen should be considered in every geriatric trauma patient presenting to the emergency room. Nevertheless, patients with chronic obstructive pulmonary disease and their need for elevated carbon dioxide levels must be identified to maintain their respiratory drive [33]. Constant and vigorous cardiopulmonary monitoring is essential on these patients throughout their hospital stay.

Most geriatric patients present with an elevated blood pressure, usually poorly controlled by their medications. Typical clinical findings may not be evident in the geriatric population due to chronic cardiovascular illnesses or medications. Changes in hemodynamics such as an increase in heart rate, a decrease in pulse pressure, and poor peripheral perfusion, all characteristics of a multi-trauma patient, may not occur in this population [34]. The patient with chronic hypertension can mask the symptoms of hypovolemia. Blood pressure can be measured as normal when the patient is actually hypovolemic.

A strong suspicion of poor tissue perfusion even when these patients present with a systolic pressure of 120 mmHg is recommended and always consider resuscitation in patients who are currently taking beta-receptor

Table 2 Vital considerations in management

1. Early evaluation of the geriatric patient
2. Resuscitation and judicious hydration with crystalloids and/or blood product transfusions if necessary, avoid situations of poor tissue perfusion
3. Inadequate adrenergic response to stress
4. Identification of current medications and appropriate optimization of pre-existing medical conditions
5. Recognize medications that could mask the classic signs and symptoms of physiological changes due to surgical urgency
6. Correction of metabolic derangements
7. Early use of radiographic diagnostic methods
8. Timely diagnosis of traumatic injuries
9. Timely surgical intervention for definitive control of traumatic injuries
10. Early use of broad-spectrum antibiotics when indicated
11. Proper pain management
12. Minimize the use of sedatives due to their high risk of developing delirium or dementia states
13. Immediate, precise and continuous patient monitoring
14. High index of suspicion for clinical deterioration

blockers or diuretics to control hypertension [35]. These medications are commonly used for heart disease and may alter usual physiologic responses. For example, there was an increase among the geriatric population of 57% in the use of β-blockers compared with 23% increase in the use of diuretics as published by the US National Health and Nutrition Examination Survey (NHANES) (2001–2010) [36]. Controlled use of crystalloid solutions and/or blood transfusions is vital to avoid developing over-resuscitation. Evidence-based medicine stresses the detrimental impact of over-resuscitation on the survival of these patients [37•]. Chemical monitoring of acidosis is essential since a base deficit of less than six is related to an increase in mortality and morbidity, along with the number of units of blood transfused in the geriatric trauma population [38–40]. Initial lactate and subsequent lactate clearance at 6 h has been proven to be an independent predictor of death in trauma patients. Mortality increased significantly for lactate clearance less than 60% with the greatest adjusted odds ratio for death for a lactate clearance of less than 30% [41]. Indications for blood transfusions should be similar to those of younger adults in trauma. Early replacement of clotting or platelet factors for patients with drug-induced coagulopathies is paramount in the acute management of geriatric trauma patients.

The effects of renal mass loss must be considered. This results in a decrease in kidney function due to poor kidney flow and a decreased glomerular filtration rate. In a geriatric trauma patient, this decreased organ function must be considered and be aware of an increased susceptibility to kidney damage [42]. Nephrotoxic medications that affect renal flow or damage nephrons directly should be avoided. The use of contrast agents for radiographic studies should be used cautiously with the expectation that these patients should be in an active resuscitation process to prevent possible damage to renal tissue.

The decrease in peripheral vascularity, reduction of fatty tissue and changes in connective tissue favor geriatric patients to increase their loss of body heat. It is extremely important to avoid hypothermia when these patients arrive in the emergency room. Liberal use of computed tomography for the diagnosis of neurological trauma is recommended due to the increased risk of brain or spinal trauma in this population [43, 44•].

The primary objective of orthopedic injury management is to proceed with the least invasive and most effective procedure in returning the patient to early mobilization. Most of these cases include early surgical intervention, but not without first applying the best possible medical optimization as to increase the survival chances of these patients. This management has presented a considerable decrease in morbidity and mortality in this group of patients [5••].

One of the most important factors affecting the geriatric population and their response to some type of surgical stress is based on the level of frailty the patient presents at the time of the trauma. Frailty is a common term used to define aging-related traits seen with physiological and psychological decline. Traits most commonly seen are chronic malnutrition, loss of appetite, sarcopenia, chronic diseases, chronic inflammation and a decrease in metabolic rate and physical activity. Patients who present a certain degree of this syndrome are predisposed to suffer more falls, succumb to surgical emergencies and present a much higher percentage of mortality compared to a patient without increased frailty [45–48•].

Another essential consideration during the evaluation of every geriatric trauma patient is holding a conversation with the patient and/or their relatives about end of life decisions. Most patients do not have advanced directives that convey the information necessary for health care professionals to avoid futile treatment. Legal, ethical, and family dynamics can be complex and challenging during the management of these patients.

Geriatric Trauma Service

Geriatric trauma patients mandate a unique hospital experience to optimize their care. A significant number of injuries among this population is related to orthopedic injuries. Pelvic, hip, and femur fractures are part of the range of injuries that could be of significant functional, mental and emotional disability to the geriatric patient [49, 50•]. Some institutions have implemented an orthopedic geriatric service resulting in better morbidity/mortality outcomes, improved patient safety, a decreased length of stay and a quicker return to baseline functional status [51•]. We went a step further in the care of geriatric trauma patients in creating and establishing a comprehensive geriatric trauma service (GTS) that includes a geriatric trauma unit (GTU) [52]. Our criteria for a GTS admission includes patients > 60 y/o with any identifiable injury related to a trauma sustained 36 h prior to presentation. The trauma team is required to evaluate these patients within 60 min of arrival to the emergency room, admission orders completed with the goal of the patient's arrival to their hospital room in less than 4 h, and a surgical intervention (non-emergent) within 36 h if required. The geriatrician or internal medicine physician is also required to evaluate these patients within 6 h of arrival to the emergency room and fulfill a complete consultation with recommendations and preoperative assessments (Fig. 1).

Ideally upon admission to the GTU, an initial evaluation by an injury prevention health practitioner should be performed. This evaluation includes a comprehensive geriatric

assessment, which is a complete assessment on the medical, psychosocial, and functional capabilities of these patients. These data will enhance the knowledge about the patient's risk assessment and prepare the team in their personalized approach in the management and treatment of each specific patient [53, 54]. It is recommended to apply the American Geriatrics Society Beers Criteria during the medical assessment as a process to identify potentially inappropriate use of medications and offering safer pharmacological therapies [55]. The trauma registry should be modified to accommodate specific geriatric patient data and outcomes which eases applying any new modifications or requirements by the Committee on Trauma by the American College of Surgeons [25].

The multidisciplinary team needed for the geriatric trauma service would include a trauma medical director (team leader), an internal medicine physician (geriatrician or hospitalist), a physical medicine and rehabilitation physician, a pain/palliative care member, a trauma coordinator, an injury prevention health practitioner, a geriatric

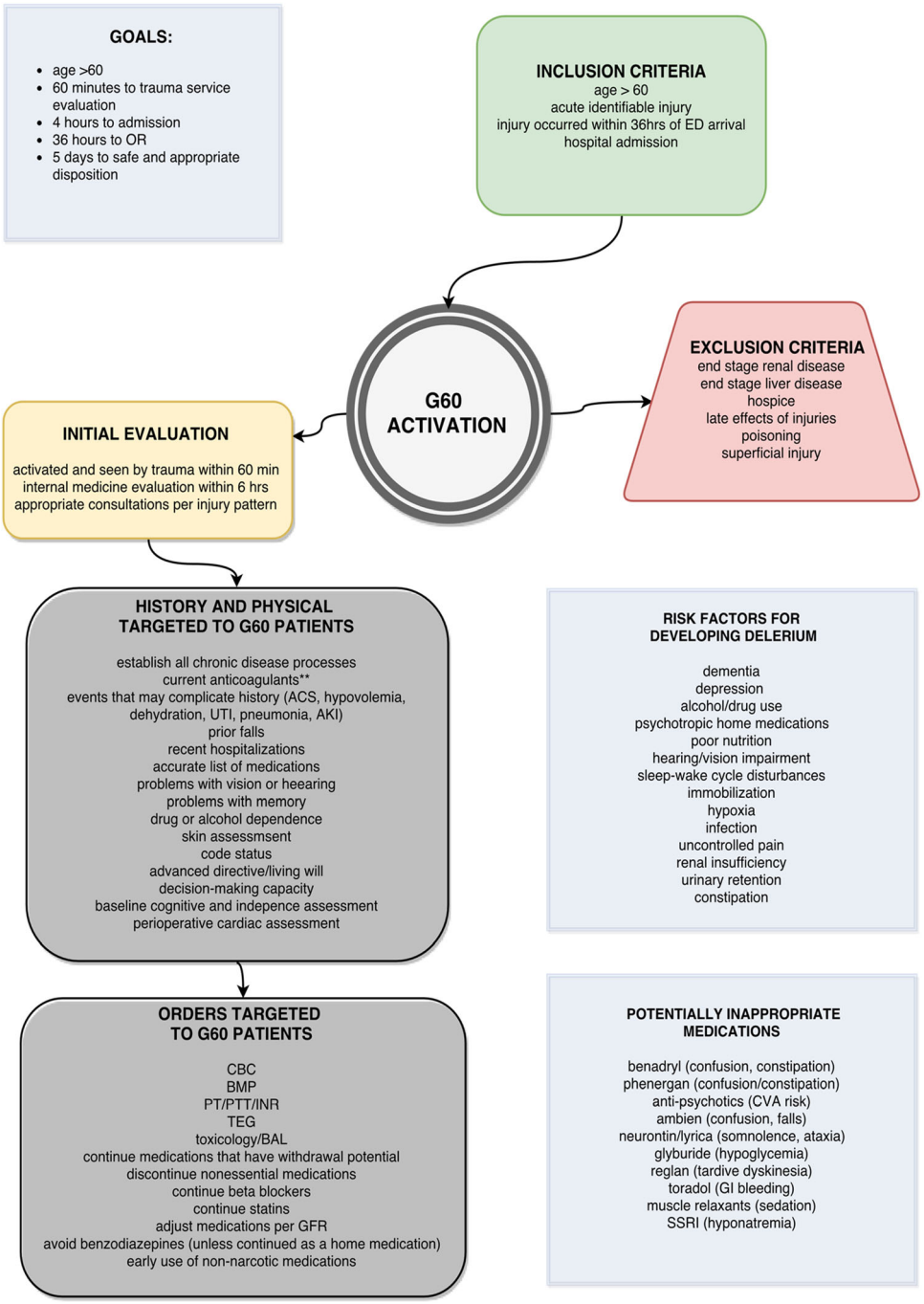

Fig. 1 G60 algorithm

pharmacist, a case management specialist, a social worker, specialized geriatric nurses and dedicated therapists on the respiratory, physical, occupational, speech and cognitive disciplines. These team members should meet biweekly in multidisciplinary rounds to discuss care plans and disposition. Protocols and critical care pathways need to be implemented upon admission to the geriatric trauma unit which is a dedicated area with telemetry capabilities and rooms equipped with special geriatric accommodations. The GTU should be committed to these trauma patients in maintaining an efficient and consistent medical process. Geriatric patients require consistent and intense therapy, as physical activity and respiratory support are imperative given that more time spent bedridden increases the patient risk of not returning to their pre-trauma daily level of physical and mental capabilities. Elder patients with increased frailty are a vulnerable population at risk for adverse health outcomes especially in the acute care setting. Multiple frailty scoring systems are available and encouraged to be used upon admission to identify the geriatric trauma patients at a higher risk [45, 56, 57].

Effective pain management can be a central determinant of success in the drive to improve pulmonary mechanics, optimize mobility, and mitigate delirium [58••]. Minimizing narcotic use among this patient population has always been a key factor in reducing adverse events during their hospital stay. A multimodal pain management algorithm is crucial for the geriatric patient, including early use of non-opioid analgesics like NSAIDS, acetaminophen, muscle relaxants, antidepressants, and/or anticonvulsants [59]. When non-narcotic analgesics are used in combination with opioids, dosing of opioids needed to effectively manage pain may be reduced. Regional anesthesia techniques need to be considered, such as a continuous intercostal nerve block for multiple rib fractures or a fascia iliaca nerve block for hip or proximal femur fractures [60–62]. These localized anesthesia techniques provide an excellent adjunct to minimizing narcotic use.

Another critical aspect of the geriatric trauma patient recovery is improving follow-up support after discharge from the hospital. It will optimize the final functional capacity and independence for daily activities that the patient will reach for the rest of their life. A few trauma centers around the nation have developed post trauma follow-up teams for establishing prevention programs and improving patient return to their daily activities [53, 63].

Geriatric Trauma Service Experience

Why establish this type of service as part of the trauma center? What would be the impact of such a system? Why it is so special? Trauma organizations have established that the geriatric trauma population requires specific guidelines for adequate management and definitive treatment [25, 54, 64]. A prospective cohort study comparing outcomes one year before and one year after establishing a GTS was performed [5••]. The number of patients in the control group (CG) was 280 compared to 393 admitted to the GTS. Both groups had an average age of 75 and 77 y/o, respectively. There was no significant difference in their injury severity scores either, 11 (control group) vs 10 (GTS group). This study demonstrated a significant difference between the groups in the average emergency department length of stay (6.1 h CG vs 4.2 h GTS), average time to surgery (52.9 h CG vs 37.6 h GTS), average ICU length of stay (5.2 days CG vs 3.0 days GTS) and average hospital length of stay (7 days CG vs 4.8 days GTS). Patients showed a decrease in complications like urinary tract infections (3.9% CG vs 1.5% GTS) and respiratory failure (6.8% CG vs 1.3% GTS) along with a decrease in mortality (5.7% CG vs 3.8% GTS). Interestingly, the authors found a significant increase in the number of patients been placed in rehabilitation facilities (7.1% CG vs 23.9% GTS). This represents a substantial effort in returning this patient to the same level of physical activity present before the trauma occurred.

After 8 years of establishing the GTS, we report that the number of geriatric trauma admissions to our institution constitute almost one third (32%) of our total number of trauma admissions (2015–2017). One fifth of our GTS admissions are direct referrals from other institutions. Common injuries seen at our institution were head trauma (27%), upper extremity fractures (24%), femur fractures (22%), vertebral fractures (16%), chest trauma (15%), lower extremity fractures (11%), and pelvis/acetabular fractures (7%). The main goals of the geriatric trauma service continue to be achieved as there were consistent numbers in hospital length of stay (5.5 days), ICU length of stay (2.4 days), and mortality (4.2%). A decrease in the time for definitive operative intervention (30.7 h) was seen as compared to previous data (37.6 h) [5••].

Conclusion

The key for the success of the geriatric trauma service is to expedite and facilitate trauma care for elderly patients via a multidisciplinary approach with the trauma surgeon as the leader. Prompt optimization of the patient's chronic illnesses is imperative to facilitate the definitive management of their injuries by the subspecialists. The data acquired on this service will also encourage research programs and foster the continuous development of prevention programs that will cater to this population. A geriatric trauma service will lead to a more streamlined hospital visit with a

reduction in morbidity and mortality. The primary goal of geriatric patient management is to return the patient to his or her baseline level of independent functioning that was present prior to the traumatic event.

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