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ACUTE GERIATRICS

Major trauma in the older patient: Evolving trauma care beyond management of bumps and bruises

Christopher R CARPENTER,[1] Glenn ARENDTS,[2,3] Carolyn HULLICK,[4,5] Guruprasad NAGARAJ,[6,7] Zara COOPER[8] and Ellen BURKETT[9,10]

[1]Department of Emergency Medicine, Washington University School of Medicine in St. Louis, St. Louis, Missouri, USA, [2]Department of Emergency Medicine, The University of Western Australia, Perth, Western Australia, Australia, [3]Harry Perkins Institute for Medical Research, Centre for Clinical Research in Emergency Medicine, Perth, Western Australia, Australia, [4]Emergency Department, John Hunter Hospital, Newcastle, New South Wales, Australia, [5]Department of Emergency Medicine, Faculty of Health and Medicine, The University of Newcastle, Newcastle, New South Wales, Australia, [6]Department of Emergency Medicine, Liverpool Hospital, Liverpool, New South Wales, Australia, [7]Department of Emergency Medicine, School of Medicine, The University of Sydney, Sydney, New South Wales, Australia, [8]Department of Surgery, Brigham and Women's Hospital, Harvard University School of Medicine, Boston, Massachusetts, USA, [9]Princess Alexandra Hospital, Brisbane, Queensland, Australia, and [10]Department of Emergency Medicine, School of Medicine, The University of Queensland, Brisbane, Queensland, Australia

Two-thirds of female and one-third of male injury-related deaths occur in those over age 65 years.[1] Falls account for 73% of cases of major trauma in patients over age 65 with road trauma constituting the majority of the remainder.[2] As injurious standing level falls and fall prevention will be reviewed later in this series, this article focuses on major trauma and geriatric management.

Hospitalisations for injury-related issues continue to increase among ageing baby-boomers prompting increasing focus on these scenarios.[3–5] After adjusting for Injury Severity Score, geriatric trauma victims have twice the mortality of younger patients and significantly longer intensive care unit (ICU) and hospital stays.[6,7] Unfortunately, even minor geriatric trauma that does not require hospital admission can be associated with functional decline and preventable re-presentations to the ED.[8] Increasing age has been recognised as one determinant of survival and post-trauma functional recovery for decades, but age alone is an insufficient marker for futility because some ageing trauma victims will benefit from aggressive trauma resuscitation.[1,9,10]

Scenario 1: Pedestrian struck by motor vehicle – highlighting team-based trauma care, geriatric imaging, analgesia and prognostication

Ruth, an 85-year-old widow who lives independently, is struck by a car whilst crossing the road. After a short pre-hospital time, she arrives in the ED with complaints of left chest pain and left groin discomfort. Your primary survey reveals a patent airway; a respiratory rate of 24/min with oxygen saturations of 94% on room air, equal air entry and bruising to her left chest; an initial pulse rate of 98/min and blood pressure of 110/50. There is bruising to her left groin and a non-tender abdomen; she is conscious and alert and the secondary survey is otherwise unremarkable. She has a history of hypertension and ischaemic heart disease.

Triage and initial clinical assessment

Although trauma mortality appears to increase from age 70, older age is associated with under-triage in the pre-hospital setting and lower rates of ambulance transfer to advanced trauma care centres.[11–13] Then, once in the ED, elderly patients are again more likely to be under-triaged than severity matched younger patients and less likely to receive trauma team activation despite higher mortality.[14,15] This may be contributed to by over-reliance on physiologic criteria. In adults ≥70 years, 63% with severe injuries and 25% with an injury severity score over 30 do not meet standard hemodynamic criteria for trauma team activation.[16] Early trauma team activation and a low threshold for ICU admission with tissue perfusion monitoring decreased geriatric trauma mortality by almost 20% in one study.[17]

Trauma assessment and management in the older person is more complex than in younger persons. Geriatric trauma assessment and management is dependent on an awareness of (Table 1):

Correspondence: Associate Professor Christopher R Carpenter, Department of Emergency Medicine, Washington University School of Medicine in St. Louis, One Brookings Drive, St. Louis, MO 63130, USA. Email: carpenterc@wustl.edu

Christopher R Carpenter, MD, MSc, FACEP, AGSF, Associate Professor; Glenn Arendts, MMed, FACEM, Associate Professor; Carolyn Hullick, MBBS, FACEM, Staff Specialist; Guruprasad Nagaraj, MBBS, FACEM, Staff Specialist; Zara Cooper, MD, MSc, Assistant Professor of Surgery; Ellen Burkett, MBBS, FACEM, Staff Specialist.

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TABLE 1. *Impacts of ageing on trauma assessment and management*

	Impacts of ageing	Clinical implications
Airway	Increased incidence of: • Edentulous • Arthritis of temporomandibular joints and/or cervical spine	Anticipate potential for difficult airway through reduced mouth opening/neck mobility; difficulty in bag-valve-mask ventilation may be reduced by leaving dentures *in situ* with removal for laryngoscopy
Breathing	Reduced respiratory reserve secondary to reduced respiratory muscle strength, vital capacity, compliance of chest wall and increased residual volume	• Early supplemental oxygen and respiratory support; apneic oxygenation for intubation • Early incentive spirometry (if no contraindications) to reduce atelectasis • Ensure optimal analgesia to reduce splinting of respirations
Circulation	• Increased peripheral vascular resistance • Decreased cardiac sensitivity to beta-adrenergic stimuli (intrinsic and/or via medications such as beta-blockers) and reduced baroreceptor sensitivity, with resultant blunting of usual tachycardic response to hypovolemia • Increased reliance on stroke volume for rise in cardiac output • Reduced pain sensation and increased abdominal wall laxity • Increased incidence of primary or secondary cardiac ischemia • Increased premorbid use of hypotensive, antiplatelet and anticoagulant agents	Increased risk of delays to recognition of shock Early identification of shock through: • Careful physical examination • Metabolic markers of tissue hypoperfusion (e.g. BD <–6) • Timely identification of sources of haemorrhage through above plus extended FAST scan and low threshold for pan-CT scan • Timely achievement of hemostasis Need for early fluid resuscitation to augment ventricular filling
Disability	Cortical atrophy with resultant increased susceptibility of bridging veins to shearing and subdural haemorrhage	Increased incidence of intracranial hemorrhage in setting of normal GCS
Exposure	Premorbid malnutrition, immunosensence	Increased risk of: • Hypothermia • Pressure injuries • Infection

BD, base deficit; CT, computed tomography; FAST, Focused Assessment with Sonography in Trauma; GCS, Glasgow Coma Scale.

1. Age-related anatomic and physiological changes, including reduced cardiac and respiratory reserve, skin and bone fragility and immunosenescence, which predispose older adults to more severe injuries for a given trauma mechanism.[4] These changes also significantly impact sensitivity and specificity of clinical findings in trauma.
2. Increased potential for medical events inciting or complicating trauma related to comorbidities.
3. Functional frailty that may impact trauma assessment (through presence of baseline deficits including cognitive impairment), management and outcome.

Resuscitation and investigation

Resuscitation of the geriatric trauma patient requires modification of

commonly used values for identification of hemodynamic or neurological compromise.[18,19] Venous lactate (≥2.5 mmol/L) or base deficit (≤–6) may better predict hemodynamic compromise than traditional vital signs.[20,21] In conjunction with early engagement of trauma surgery, lactate monitoring for occult hypoperfusion could reduce mortality.[22]

Age has not been identified as an independent predictor of outcome in patients undergoing massive transfusion, and massive transfusion protocols should be activated equivalently for an older person.[23] Use of a permissive hypotension with a systolic target of <90 mmHg, as a component of damage control resuscitation in older persons, is controversial. Although mortality rises with lower admission systolic blood pressure, there was no synergistic effect of age and blood pressure on mortality in one retrospective study.[24]

The increased incidence of severe injury and mortality and the reduced sensitivity of clinical findings, support a liberal approach to pan-CT scanning in geriatric trauma. ED physicians adopting this approach need to be aware of and prepared to manage the high rates of incidental findings.[25] Though the risk of contrast-induced nephropathy is often raised, a retrospective study of non-ionic iso-osmolar intravenous contrast in older trauma patients demonstrated no association between intravenous contrast media administration and acute kidney injury.[26]

Injury management

Post-trauma pain management in older trauma victims is often suboptimal.[27] Rib fractures are a common cause of morbidity and mortality in the older trauma patient, with one study identifying that mortality increased (odds ratio for death of 1.19) for each additional rib fracture.[28] Appropriate analgesia for rib fractures is critical to reduce splinting of the chest wall and optimise vital capacity.[29] Although intravenous opioid analgesia (in cognitively intact persons ideally via patient-controlled analgesia) is generally utilised as an initial approach in the ED setting, we prefer opioid sparing, multimodal shared decision-making approaches to analgesia including regular paracetamol and regional anaesthesia.[30,31]

Pelvic fractures in geriatric trauma are common, with lateral compression fractures the most common.[32] Rates of clinically significant haemorrhage associated with pelvic fractures are significantly higher in elderly.[33] Sensitivity of plain trauma series pelvic films for posterior pelvic ring fractures is unacceptably low with up to 97% of posterior pelvic ring fractures missed when pubic rami fractures are present.[34,35]

Central to management of the geriatric trauma patient is the evolving concept of shared decision-making, with the cognitively intact patient or with alternate health decision-makers in those patients lacking decision-making capacity.[36] Informed decision-making in this setting requires an understanding of likely prognosis with respect to survival and functional outcomes. Trauma-related mortality for geriatric victims with severe injuries has been declining in Australia for the last decade.[37] A study of 38 707 older trauma patients showed that 90% of seriously injured older adults survived to hospital discharge, with 52% discharged directly home, 20% discharged to rehabilitation and 25% discharged to a residential aged care facility.[38] The presence of pre-existing comorbidities increased the odds of complications three fold. Frailty also increases risk, but objective measures of frailty are not widely accepted across surgical or medical specialities.[39,40]

Scenario 2: Motor vehicle accidents – assessing beyond the acute injuries

Alfred is a 92-year-old Veteran of World War II who arrives to the ED via ambulance, after the vehicle he was driving accidentally struck one of his neighbours while she was crossing the street. When he slammed on his brakes, his forehead struck the steering wheel and he was knocked unconscious. Upon his arrival in the ED he is awake and communicative with a Glasgow Coma Scale (GCS) score of 15, but very concerned about the woman that he struck and emotionally distraught. You note a golf ball size hematoma over his forehead. Your primary and secondary trauma surveys are otherwise unremarkable, but you note that he takes apixaban for atrial fibrillation. He is otherwise robust and well.

By virtue of their common cortical atrophy and high use of antiplatelet/anticoagulant medications, older persons are at higher risk of intracranial injury despite normal GCS.[41] While the incidence of traumatic intracranial bleeds is extensively researched for warfarin,[42–44] new oral anticoagulation (NOAC) therapies include direct thrombin (dabigatran) or Factor Xa (rivaroxaban and apixaban) inhibitors.[45] Traditional measures of anticoagulation (PT, PTT) do not provide information about the degree of anticoagulation with NOACs. Furthermore, their effective reversal requires a shift away from fresh frozen plasma with vitamin K and towards prothrombin concentrate complex or activated Factor VII.[46] Researchers and pharmaceutical manufacturers continue to explore safe, effective and costly reversal agents for NOACs, such as andexanet alpha (factor Xa inhibitor reversal agent).[47] Idarucizumab, a monoclonal antibody to reverse dabigatran, is currently the only NOAC reversal agent registered in Australia.[48]

The Canadian Head CT Rule identifies age 65 or older as an independent risk factor for 'high-risk' head injuries that require CT imaging.[49] A normal brain CT does not eliminate the risk of a delayed intracranial bleed, but from that point management and the decision to admit or discharge is mired in controversy. The incidence of delayed intracranial haemorrhage among traumatic brain injury (TBI) victims taking warfarin and/or antiplatelet agents ranges from 0.6% to 6%, and most delayed bleeds are clinically inconsequential and require no surgical intervention.[50–53] Bleeding presentations can be delayed

weeks, especially subdural bleeding. Routine admission for every warfarin-anticoagulated victim with a normal brain CT would cost over $1 million per life saved, which is neither practical nor cost-effective.[54]

Our approach is again based on shared decision-making and a risk-benefit analysis. With the patient's agreement, families and carers are educated about the risks and signs of delayed brain bleeding. We do not recommend routine repeat CT scanning. It is prudent for the patient to see their General Practitioner in the days after discharge for clinical review and re-evaluation of the indication for anticoagulation. Admission is offered where safe home observation or certainty of follow up cannot be established AND it is felt the risks of discharge exceed those risks of hospitalisation we have discussed elsewhere in this series.[55]

Operative management of TBI in patients over age 75 is associated with higher mortality. A GCS of 8 or less implies a 70% overall mortality in geriatric TBI victims and survival over the age of 85 with this severity of brain injury is extremely rare.[56,57] The dismal outcomes in very old TBI victims led to the Eastern Association for the Surgery of Trauma (EAST) Guideline recommendation of 'discussions regarding the goals of care if no improvement in GCS is seen after the initial phase of care and after withdrawal of sedatives' following 72 h of aggressive trauma management.[58] Early engagement of palliative care and/or geriatrics for critically injured trauma and TBI victims can improve symptom management and reduce intensive care unit and hospital lengths of stay without increasing mortality.[59–61] The EAST Guidelines may require revisions because more recent research indicates that half of TBI patients with persistent GCS ≤ 8 after 72 h are ultimately discharged from the hospital alive and over half of those discharged are still alive 12 months later, albeit with universal functional impairment.[62]

Blunt head or neck trauma in ageing adults is associated with cervical spine fractures. Since geriatric-specific C-spine decision aids have not been validated, we support a low threshold to image the cervical spine.[63–65] CT is more sensitive than plain films for detecting spine fractures at the cost of preventable over-diagnosis and over-treatment of insignificant fractures or incidental findings unrelated to the trauma.[66,67]

Conclusions

Managing major trauma in geriatric adults requires a low clinical threshold for advanced imaging and multidisciplinary assessment, recognising that mechanism and physical examination can be deceiving. Physiological and anatomical changes of ageing increase trauma-related mortality. Efficient laboratory, imaging and disposition decisions require an understanding of typical injuries and common resuscitation pitfalls, as well as recovery trajectories and preventative strategies to reduce short-term functional decline or further injury.

Competing interests

None declared.

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