Challenges of prehospital silver trauma patients

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Silver trauma patients, defined as those aged >65 years who have traumatic injuries, are a complex group because physiology alters with age leading to difficulties with assessment. This is exacerbated within the prehospital setting as environmental factors and ambulance delays increase the risk of complications. This article focuses on the pathophysiology and application of clinical guidelines on three aspects of prehospital silver trauma: neurology, osteology and haemorrhage. Neurologically, silver trauma patients have a higher risk of traumatic brain injury and are harder to assess because of age-related cognitive decline. Regarding osteology, older people, particularly postmenopausal women, are at a higher risk of vertebral fracture, with many going undiagnosed. Haemorrhage is also influenced, as geriatric patients typically experience occult bleeding or rebleeding several days after an event when crews have left. Despite these risks, prehospital guidelines often offer little support for clinicians in making holistic, clinically sound decisions for their patients.

Silver trauma is a relatively new phrase describing major trauma in patients aged >65 years (Chowdhury, 2020). Previously, major trauma was thought to occur mainly in working-age patients with high mechanism of injury. However, a report by the Trauma Audit and Research Network (2017) revealed most major trauma patients were aged >60 years with low mechanism of injury, although people aged >65 make up only 18% of the UK population
(Atinga et al, 2018).

Older people have an altered physiology which increases their chance of major risk despite low mechanism of injury so they may require different treatments. Such changes also make prehospital assessment and identifying injuries challenging.

However, unlike paediatric patients, who have their own guidelines because of their specific physiology, older people receive the same treatment as younger adults. This article discusses neurological, haemorrhage and osteological pathophysiology, prehospital assessment and the effectiveness of two prehospital guidelines, those of the Joint Royal Colleges Ambulance Liaison Committee (JRCALC) (Brown et al, 2019) and National Institute of Health and Care Excellence (NICE) (2016; 2019), when applied to geriatric patients. These guidelines were chosen because they are frequently used in prehospital care.

Context

Falls are the primary cause of trauma in older people, causing a multifactorial geriatric syndrome including major trauma despite low mechanism of injury (Saxton et al, 2019). Factors such as frailty, social problems and comorbidities increase the risks of falls and complications from them (Cooper and Shenvi, 2017).

Assessing these patients is challenging as sensory issues and cognitive decline inhibit communication and observations are influenced by patients' pre-existing conditions (Buurman et al, 2021). This is exacerbated by potential lengthy times spent lying down because ambulances are delayed due to raised demand, which increases the risk of complications and hospital attendances (Association of Ambulance Executives, 2021).

Experts agree holistic approaches are needed for ethical treatment; however, this is a grey area because difficulties regarding consent challenge clinicians. The evidence base for treatments is tenuous as clinical trials are usually applied to the adult population but those aged >85 years are typically excluded from these (Bellou et al 2016).

There are conflicting views over whether guidelines should differentiate between young and geriatric patients with Atinga et al (2018) advocating that older people are a unique patient group and this should be reflected in their treatment. In contrast, McQuillan and Makic (2020) counter that management based on age alone is inappropriate as advanced age does not predict poor outcomes.

Therefore, trauma in elderly people is a demanding area of medicine.

Neurology

A key role of prehospital clinicians is assessing whether transportation to hospital or referral to primary care would best meet a patient's needs.

Caution should be taken when assessing older people's head injuries, as their physiology, which has changed with age, means traumatic brain injuries can be more dangerous and harder to identify. Neurons are not replaced from birth, causing brain atrophy and the space between meninges to increase as patients age (Hubert and VanMeter, 2018). This increased space stretches the bridging cortical blood vessels between the skull and brain, making them prone to injury from abrupt shearing forces from trauma (Bickle, 2022). These vessels become brittle and less capable of reacting to pressure changes during the coup and contrecoup phases (Pierre and Kondamudi, 2021).

Lifestyle factors also alter physiology, as McCance and Huether (2019) explain; smoking and atherosclerosis reduce cerebral perfusion pressure, worsening brain atrophy and increasing dementia risk, indirectly causing trauma and making assessment more difficult.

Challenges of neurological injury assessment and decision making

Jones (2020) reported that assessment of neurological injury is complicated as geriatric patients may not exhibit symptoms until the brain's potential space is filled and intracranial pressure increases. This study reported that young traumatic brain injury patients would have a Glasgow Coma Score (GCS) of nine whereas a geriatric patient with a brain injury of the same severity brain scan has a GCS of 14.

Traumatic brain injury cadaveric studies reveal signs of repeated haemorrhage (Bickle, 2022), suggesting patients may form temporary clots before rebleeding, which demonstrates why symptoms may take days or weeks to present. This risks the patient being alone and unable to seek help when symptoms occur.

Another problem is that when symptoms such as transient confusion or sensory impairments do occur, they can mimic common geriatric syndromes such as dementia. Cooper and Shenvi (2017) warned symptoms could easily be misattributed so clinicians must complete careful comparisons of differences between a patient's current and normal presentation.

The presence or absence of symptoms does not rule serious brain injury in or out. As a result, hospital attendance for a CT head scan is usually recommended following head trauma; the consequences of undiagnosed intracranial haemorrhage can be fatal.

However, unnecessary hospital attendance burdens the NHS because of transportation and medical costs and the additional staff workload required to care for frail, complex patients.

Additionally, patients may become distressed, being reluctant to travel to hospital unnecessarily. Prolonged hospital stays risk institutionalisation and deconditioning, further increasing falls risk and acopia (Nickel et al, 2021). Consequently, decisions surrounding conveyance to hospital are complex, multifactorial and inherently high risk so clinicians use guidelines to support decision-making.

It is imperative that guidelines chosen by clinicians relate to the patient they are applied to. Within a prehospital setting, JRCALC (Brown et al, 2019) and NICE (2019) head injury guidelines are most used by prehospital crews so will be discussed further.

The JRCALC guidelines (Brown et al, 2019) emphasise that clinicians should be highly suspicious of traumatic brain injury in geriatric patients, reporting frequent head injuries in patients >65 years because of age-related structural changes, and warn of atypical presentation because of pre-existing cognitive decline.

Meanwhile, NICE (2019) fails to highlight geriatric pathophysiology as a risk factor; instead, it advises paramedics receive training on identifying risk factors. While clinicians should identify age as a risk factor, arguably this omission means they are not appropriately signposted towards the risks associated with ageing.

While it should be acknowledged that NICE's (2019) hospital discharge criteria could guide prehospital decision-making, they are arguably insufficient. Without utilising this criteria, the guideline completely disregards non-conveyance and could be considered exclusive, unsafe and unsupportive of geriatric patients.

Only the JRCALC guidelines (Brown et al, 2019) acknowledge the necessity of holistic approaches regarding transportation or discharge decisions, encouraging comprehensive assessment, making decisions on a risk/benefit basis and using local pathways to prevent admission when safe. Indeed, JRCALC provides comprehensive discharge criteria that safeguard geriatric patients. However, as well as not mentioning non-conveyance, NICE
(2019) also does not offer safety netting advice for patients who do not attended the emergency department.

Holistic, patient-led care is established as gold standard elderly care; the British Geriatric Society (Buurman et al, 2021) advocates that care should be proactive, and encourage functioning and independence. It argues that prehospital management of older people should consider their altered physiology and ethical considerations when making decisions, agreeing with JRCALC's approach.

Similarly, Nickel et al (2018) discuss alternative care models, reporting that traditional hospital conveyance increases the risk of iatrogenic injury while hospital avoidance schemes specialising in geriatric physiology improve patient recovery and life quality.

Overall, it is clear that a holistic approach should be taken but clinicians should remain cautious of the inherent risks of head injury within the geriatric patient group. Use of decision-making tools and safety netting also reduces risks to patients.

Osteology

Older people are predisposed to fracture, which is a primary cause of morbidity in this group, and this arises because of physiological bone structure changes during ageing (Nursing Times, 2017).

Bones consist of spongy, cancellous material which keeps them lightweight, with a hard shell comprising collagen fibres providing flexibility and a framework where various calcium compounds can be deposited. These deposits create hydroxyapatite, which calcifies to provide strength. The balance of collagen and calcium ensures bones are hard but not brittle (Biga et al, 2019).

Bone tissue is maintained through: osteoblasts, which secrete osteoid and other essential materials into the bone matrix; osteoclasts, which reabsorb bone by-products; and osteocytes, which control remodelling by manipulating these two cell types (Cawley et al, 2020). Consequently, factors that influence these cells are pivotal to protecting against or causing bone disorders such as osteopenia.

Osteopenia occurs in older people because ageing shifts the balance between osteoblast and osteoclast activity with the result that more bone is absorbed than created (Waugh and Grant, 2018). This develops into osteoporosis, making fracture more likely despite low mechanism of injury (Borgstrom et al, 2020).

The pace of bone deterioration varies, dependent on several key factors.

One factor is oestrogen, a known regulator of bone metabolism in both sexes. Khosla et al (2012) demonstrated that oestrogen promotes osteoclast apoptosis while reducing osteoblast and osteocyte apoptosis, encouraging bone formation. Corpas et al (2021) supported this, reporting that low oestrogen levels triggered T-lymphocytes to increase osteoclastic cytokines, increasing osteoclast simulation and osteoblast inhibition, encouraging bone absorption.

Once protective oestrogen is lost after the menopause, women lose bone density rapidly, predisposing them to osteoporosis (Cauley, 2015). Furthermore, decreased oestrogen reduces muscle mass, further increasing frailty and the risk of falls (Padilla Colón et al, 2018). Other risk factors include certain disorders that influence the thyroid or sex hormones, long-term medications such as steroids and malabsorption conditions (NHS, 2019).

Vertebral fractures are the most common injury caused by osteoporosis, yet up to 70% go undiagnosed, according

to the Royal Osteoporosis Society (2020). These fractures, particularly above C6, can cause life-threatening paralysis of essential functions so avoiding excessive movement is essential (American College of Surgeons, 2018). Consequently, potential vertebral fractures must be identified and managed within the prehospital environment.

Challenges of spinal injury assessment and treatment

NICE's *Major Trauma: Assessment and Initial Management Guideline* (2016) and JRCALC's *Spinal Injury and Spinal Cord Injury* section in its clinical guidelines (Brown et al, 2019) agree that manual in-line stabilisation (MILS) should be employed at the earliest opportunity.

However, while JRCALC recommends whole spine immobilisation, NICE suggests only cervical spine immobilisation, with whole spine involvement only when lower vertebral injury is suggested. The latter guideline risks worsening vertebral injury; Fernández-de Thomas and De Jesus (2022) reported that thoracolumbar junction fractures between T12 and L1 are the most common vertebral fracture and may present asymptomatically. Additionally, Ishikawa et al (2020) warned that osteoporotic fractures were commonly asymptomatic. This means geriatric patients with vertebral fractures may not be identified or appropriately managed if practitioners are following the NICE (2016) guidelines.

Guidelines also differ in their recommendation of immobilisation based on age. NICE (2016) uses the Canadian C-spine rules to decide immobilisation so includes immobilising patients aged >65 years on mechanism alone. Contrarily, JRCALC (Brown et al, 2019) uses its own algorithm to recommend immobilisation, which does not distinguish patients by age.

Benchetrit et al (2022) weighed up the benefit versus risk between Nexus C-Spine rules, which, like the JRCALC guidelines do not recommend immobilisation on age alone, and the Canadian C-Spine rules which do. They report that, while Nexus C-Spine rules are less sensitive, inconsistencies in literature and negative consequences of inappropriate immobilisation have led to a change in recommendations to patient-specific management.

Similarly, a literature review by Peck et al (2018) supported JRCALC in advocating for a patient-led approach. They acknowledged that prehospital immobilisation was widely accepted but ultimately argued the evidence base for it was poor. They further commented that geriatric patients frequently have comorbidities which reduced the benefit of immobilisation, so recommend assessing patients individually when deciding on MILS technique.

McGraw and Strecker-McGraw (2016) reported Peck et al's approach failed to acknowledge that ethical considerations limit the available evidence base but otherwise correlates with many reliable guidelines.

Ultimately, spinal immobilisation should always aim to involve the whole spine where possible to prevent exacerbation of unstable fractures below the cervical spine. The decision to immobilise should be made using a holistic approach and must be personable, defendable and based on sound clinical reasoning.

Haemorrhage

Following trauma, clinicians should consider occult haemorrhage in geriatric patients as they are at a high risk of internal haemorrhage following low mechanism of injury. The causes of haemorrhage include vessel stenosis preventing absorption of blunt trauma forces, fractures damaging periosteal vessels and fractures damaging blood vessels in surrounding tissues (Eichinger et al, 2021).

During haemorrhage, a coagulation cascade activated by vitamin K and reliant on coagulation factors leads to clots being formed over wounds to reduce bleeding (Girolami et al, 2018). Occult haemorrhage can develop into hypovolaemic shock as circulating blood volume decreases. As haemoglobin decreases, cells convert to anaerobic respiration; lactic acid is released, causing acidosis and triggering respiratory compensatory mechanisms such as tachypnoea (Hooper and Armstrong, 2022). Roberts et al (2019) report stretch and baroreceptors in the aorta and carotid artery detect hypovolaemia, triggering catecholamine release causing arteriolar constriction, vasoconstriction and tachycardia, with the aim of increasing cardiac output.

These efforts are often ineffective in geriatric patients; the London Operational Delivery Networks (2018) reported

normal geriatric physiology and myocardial deterioration makes catecholamines ineffective at increasing contractility, while Delicce and Makaryus (2022) explained preload reduction further decreases contractility as per the Frank-Starling law.

Clinicians may not identify hypotension in patients with pre-existing hypertension, believing their blood pressure to be normal. Additionally, older patients frequently take medications that interrupt normal compensatory mechanisms; for example, beta-blockers prevent tachycardia while anticoagulants block vitamin K or factor Xa production depending on the anticoagulant class, inhibiting the clotting processes (British National Formulary, 2022). Nolan and Pullinger (2014) conclude these combined factors result in continued haemorrhage, low cardiac output, hypoperfusion, organ failure and death.

Challenges of assessing and treating occult haemorrhage

Assessing occult haemorrhage in geriatric patients outside hospital is difficult because of the lack of early symptoms during compensated shock, making diagnosis near impossible.

Presenting symptoms may be assumed to be normal geriatric syndromes; for example, reduced GCS can be mistaken for dementia (Cooper and Shenvi, 2017). Additionally, obtainable observations may not be reliable, with Tzadok et al (2019) finding that vital signs failed to detect trauma severity in geriatric patients, while Roberts et al
(2019) and Di Carlo et al (2021) reported prehospital observation methods were insensitive at identifying occult haemorrhage until decompensated shock manifested.

Eichinger et al (2021) recommended lowering the shock threshold for older people as ‘pseudo stability’ resulted in them being under triaged. Therefore, it is reassuring that NICE's *Major Trauma: Assessment and Initial Management Guideline* (2016) and the *Trauma Emergencies in Adults—Overview* section in JRCALC's guidelines (Brown et al, 2019) do not focus on numerical observations but use patient presentation to guide treatments.

Intravenous fluid replaces lost blood volume, assisting with heart contractility to maintain cardiac output (Brooks, 2017). NICE (2016) recommends clinicians ‘use physiological criteria’ including haemodynamic status and volume resuscitation response to guide intravenous fluid decisions. JRCALC advises volume resuscitation should be given to maintain palpable peripheral pulses or where impaired major organ perfusion is suspected. This approach is a departure from historical treatment where trauma patients were given sodium chloride in a 3:1 ratio compared to the blood volume lost, which resulted in huge boluses being given (American College of Surgeons, 2008). The current understanding is that conservative management prevents haemodilution and subsequent hypertension damaging clots and restarting haemorrhage (American College of Surgeons, 2018).

Another treatment is tranexamic acid (TXA), which inhibits fibrinolysis to prevent rebleeding (Draxler et al, 2021). Both NICE (2016) and JRCALC (Brown et al, 2019) advise crews give TXA within 3 hours of haemorrhage. This is influenced by the Clinical Randomisation of an Antifibrinolytic in Significant Haemorrhage 2 (CRASH-2) trial, a large randomised control trial assessing the effectiveness of TXA in adult trauma patients, which found early TXA administration reduced mortality from haemorrhage (Shakur et al, 2010). However, only 23% of the patient group was aged >44 years despite trauma in those aged >65 years accounting for more than one in four major trauma patients (Atinga et al, 2018). Yeguiayan et al (2011) acknowledged CRASH-2's young patient group, noting that anticoagulant medications were unlikely to have been prescribed and questioning the trial's relevance to older patients.

However, many studies, including those by Zhou et al (2019) and Xing et al (2020), have shown TXA is beneficial in geriatric trauma by reducing haemorrhage. Evidence shows TXA is a valid and valuable treatment for older patients so should be given at the earliest opportunity where haemorrhage is suspected.

Early recognition of haemorrhage is essential for timely treatment to be given. JRCALC's section in its guideline that covers TXA (Brown et al, 2019) states haemorrhage is indicated with tachycardia at 110 beats per minute or hypotension where systolic blood pressure is <90 mmHg. However, its section on trauma emergency contradicts this, encouraging the use of patient presentation to guide treatment. As discussed, geriatric patients conceal haemorrhagic shock and present with ‘normal’ vitals, so the TXA guideline will fail to identify compensated shock

patients.

Indeed, Di Carlo et al (2021) stated using vital signs to identify haemorrhagic shock should be avoided, explaining it is unreliable as all patient groups, including older people, compensate differently depending on a wide variety of factors. Dunham et al (2017) found vital signs were unreliable markers of haemorrhagic shock compared to base deficit blood testing, which is rarely available prehospitally. This questions whether prehospital identification of the early stages of shock is feasible in all age groups, not just geriatrics.

Patients with compensated haemorrhagic shock gain the most out of early TXA administration as several studies have shown. For example, Li et al (2021) and Almuwallad et al (2021) demonstrated there was a direct correlation between the time of TXA administration and mortality. Rapid identification of haemorrhage is therefore essential.

One developing method of assessing haemorrhagic shock prehospitally is the use of end-tidal carbon dioxide

(EtCO$_2$) monitoring. Patients in haemorrhagic shock have poor systemic perfusion. This results in less carbon dioxide requiring excretion via expiration, which can be assessed by clinicians via EtCO$_2$ monitoring.

Research into the use of this is proving successful; a study by Bulger et al (2021) found EtCO$_2$ testing to be accurate at identifying patients in haemorrhagic shock, with hypocapnia being associated with poor patient outcomes and worsened states of clinical shock. While further research is required before paramedic use, this could improve the accuracy of prehospital triage of trauma patients. Until then, guidelines should prompt clinicians to consider haemorrhage in the context of 'normal' observations, subtle symptoms and mechanism alone (Cannon, 2018).

Consequently, the JRCALC (Brown et al, 2019) and NICE (2016) haemorrhage guidelines fail to wholly support clinicians to recognise haemorrhage but do support the appropriate treatment of geriatric patients.

Conclusion

Prehospital assessment of geriatric trauma patients is complex, making assessment challenging. Altered physiology, an inability to communicate symptoms and the incidence of severe injury despite low mechanism of injury mean older people with traumatic injuries are frequently missed or undertreated.

Conveyance to hospital decreases patient quality of life and is expensive, so holistic, patient-centred approaches are recommended for older people; however, missed injuries and non-conveyance can prove fatal as late recognition of injury has huge impacts on geriatric patients. This makes decision-making processes difficult for prehospital teams.

Guidelines used to support clinicians' decision-making regarding assessment and treatment are typically blanket rules for adults which are not always appropriate for older people.

On review, the NICE guidelines (2016; 2019) are not always effective for prehospital assessment and management. The JRCALC guidelines (Brown et al, 2019) better address prehospital assessment and treatment. Inconsistencies between guidelines causes confusion. Overall, the JRCALC guidelines (Brown et al, 2019) should be applied to geriatric trauma patients by prehospital crews for most injuries.

Key points

- Older people with traumatic injuries are complex patients whose physiology can make assessment difficult Patients in the prehospital
- environment are more challenging to assess and treat, and are more likely to have conditions exacerbated by environmental factors and ambulance delays
- Hospital conveyance decreases patients' quality of life and is expensive; however, missed injury and non-conveyance may prove fatal, making decision-making difficult for prehospital clinicians
- Guidelines are often used to assist with clinical decision-making; however, these offer little support for clinicians in making holistic, clinically-sound decisions for their patients

CPD Reflection Questions

What factors should be considered when deciding whether an older patient should be taken to hospital?Should there be prehospital silver trauma guidelines?

- Is it possible to make reliable, practical prehospital silver trauma guidelines? What factors would you consider or include?