RESEARCH

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Delta Alert: Expanding Gerotrauma Criteria to Improve Patient Outcomes: A 2-Year Study

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ABSTRACT

Background/Significance: Because of their decreased physical reserve and increased risk of complications, the geriatric trauma patient (GTP) population warrants heightened awareness by clinical staff.

Purpose: The purpose of this study is to determine whether the institution of a third-tier trauma protocol results in a change in GTP outcomes, complications, and mortality rates.

Methods: Researchers conducted a retrospective review of 2 years of data from the trauma registry, hospital quality improvement audits, and patient charts to examine what, if any, patient outcomes were impacted by the institution of the expanded GTP protocol.

Results: Sample homogeneity was determined. Emergency department (ED) length of stay and time to the operating room decreased in the protocol cohort. The rate of complications decreased from 16.4% preprotocol to 1.6% postprotocol. Discharge to home rates in the GTP population improved from 31% preprotocol to nearly 77% postimplementation of the protocol.

Discussion: The expanded GTP protocol front loads evaluation and resuscitation to be consistent with ED trauma protocols already in place. By fast-tracking radiology and laboratory testing, patients injuries are identified and the appropriate consultations are initiated. Appropriate inpatient nursing unit placement is identified or treatment and discharge from the ED are expedited.

Conclusion: The expanded GTP protocol provided early and comprehensive evaluation and interventions for GTPs who fall outside of traditional trauma alert criteria. Patients spend less time in the ED and the hospital. Patients had decreased length of stay in the ED, less complications, and return to home rates showed significant improvement after the protocol was implemented.

Key Words

Geriatric trauma, Patient outcomes, Practice guidelines

Because of their decreased physical reserve and increased risk of complications, the geriatric trauma patient (GTP) population warrants heightened awareness by clinical staff. Establishing an additional trauma alert specifically targeting GTPs who do not meet this institution's trauma alert criteria but who are at risk for poor outcomes strives to decrease morbidity and mortality (M&M) by early identification of injuries, proper specialty group referrals, and coordination of interdisciplinary care (Wiles, Day, & Harris, 2016). In addition, the new GTP alert criteria aligns with the goals of the American College of Surgeons (ACS) Committee on Geriatric Trauma (American College of Surgeons, 2015) and trauma guidelines established by the Emergency Nursing Association (Emergency Nurses Association, 2014) and Society of Trauma Nurses (Graymire, Henn, Schroeter, & Seislove, 2008) by expanding criteria and lowering the threshold for trauma activation when caring for this high-risk population.

At this institution, the newly established GTP trauma alert is referred to as a Delta Alert. A Delta Alert is called for GTPs 65 years of age and older who take anticoagulant or antiplatelet medications other than aspirin; sustain a ground-level fall with altered level of consciousness or neck pain, hip/pelvic/thigh pain or deformity, and low-impact bike or motor vehicle accidents; and those who suffer blunt head or torso trauma. The trauma designation provides immediate physician and nursing assessment and expedites diagnostic processing and treatment. Patients who require admission are assigned to the hospitalist or the intensivist, depending on the severity of their injury, with specialty consultation and treatment as needed (Wiles et al., 2016). Although these patients have sustained traumatic injuries, they do not meet the higher acuity trauma activation guidelines for mechanism or severity of injury already in place at this trauma center.

REVIEW OF LITERATURE

The landscape of geriatric health care is shifting and includes the highest number of GTPs ever, which necessitates improved triage criteria. Factors such as

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coagulopathy, goals of care, and continuing education for surgeons are increasingly important to maintain optimal care of the GTP (Calland et al., 2012). To accomplish this, it is necessary to incorporate those elements that address the unique physiological and anatomical challenges of the elderly patient into the already established tenets of adult trauma resuscitation (Adams & Holcumb, 2015).

Elderly patients have greater complexity than younger patients because they often present with preexisting disease processes and take more medications. In addition, they often have a more covert response to trauma. Because of these and other factors, the sensitivity of adult trauma guidelines is insufficient in the elderly population (Calland et al., 2012). A best practice approach for geriatric trauma is to determine how to predict M&M in the geriatric population. The Injury Severity Score (ISS) has been found to be the most predictive of elderly trauma mortality, with blood requirements, fluid requirements, and the Glasgow Coma Scale (GCS) score also having a strong correlation (Tornetta et al., 1999).

A study reporting the need for aggressive assessment, prioritization, and management for GTPs found that elderly men and women were undertriaged 18% and 15% of the time, respectively, compared with young subjects and middle-aged men who were undertriaged 8% of the time (Scheetz, 2003). Furthermore, elderly trauma patients with decreased reserve had three times greater failure to rescue or death from a major complication than younger patients (Joseph et al., 2016). Patients 80 years of age and older had the poorest outcomes, particularly at hospitals without a trauma designation (Meldon, Reilly, Drew, Mancuso, & Fallon, 2002).

The scope of geriatric trauma alert criteria is varied and includes the patient's level of consciousness measured by GCS and mechanism of injury (MOI) as well as highly specified physical findings such as suspected rib fractures. With the recent evolution of novel anticoagulants, some suggest incorporating usage of these drugs into alert criteria (American College of Surgeons, 2015). In one study, four criteria were incorporated into a trauma alert: GCS, MOI, comorbid conditions, and anticoagulant use (Rogers et al., 2012). Data were compiled to determine the over- and undertriage of GTPs. As with other studies, confounding variables limited the ability to test the relationship between criteria and outcomes.

It is well established that rapid assessment, recognition of traumatic injury, and expeditious transfer to a designated trauma center result in improved mortality and morbidity in all trauma patients (Calland et al., 2012). Despite this fact, GTPs often do not receive this level of care. Much of the gap in triage and transfer of elderly trauma patients is due to their lack of physiologic and anatomic parameters typically seen in the adult trauma patient (Hranjec, Sawyer, Young, Swenson, & Calland, 2012). In response, the American College of Surgeons and the Eastern Association for the Surgery of Trauma developed guidelines for the care of the GTP to adjust for this gap. These guidelines account for comorbidities and physiologic changes associated with aging and recommend expansion of trauma guidelines in the GTP population to lower the MOI threshold, particularly in patients taking anticoagulants (Calland et al., 2012). Data studying integration of these guidelines and outcomes from centers where these guidelines are used are not prevalent in the literature.

Ohio has established statewide guidelines for GTPs. These criteria include GCS score of less than 14 in the presence of traumatic brain injury, systolic blood pressure less than 100 mm Hg, fall from any height with obvious head injury, multiple body system involvement, being hit by a moving automobile, and having a long bone fracture following a motor vehicle accident (Werman, Erskine, Caterine, Riebe, & Valasek, 2011). A study compared the newly established Ohio 2009 Trauma Guidelines for older adults with those of the state's prior standard adult triage criteria to determine sensitivity of adult criteria in the geriatric population. Results found that only 57% of GTPs met the adult criteria, whereas 68% of the same GTPs met the expanded criteria for older adults. The new Ohio older adult trauma guidelines were able to significantly increase the sensitivity for trauma (Ichwan et al., 2015).

Further research is needed to establish direct correlation between geriatric trauma alert and outcomes, complications, and mortality. The purpose of this study is to examine the difference in patient care outcomes between two cohorts of GTPs pre- and postinstitution of an expanded GTP protocol.

METHODS

After obtaining institutional review board's approval, researchers conducted a retrospective chart review study design to compare two cohorts of patients. The independent variable was the Delta Alert cohort treated using the expanded trauma protocol. Outcomes that served as dependent variables were length of stay (LOS) in the emergency department (ED) and the hospital, time to operating room (OR), patient disposition from the ED or the hospital, mortality rate and, complication rates. These criteria were chosen as they are tracked and reported as part of the ACS Trauma Quality Improvement Plan (American College of Surgeons, 2015) and have been found to have a direct correlation to patient outcomes.

Data from the trauma registry, hospital quality improvement audits, and patient charts were reviewed to examine what, if any, patient outcomes were impacted by the institution of the GTP protocol. Deidentified data was reviewed and no demographic data other than age and patient residence status upon admission were collected. Additional

data obtained included ISS and anticoagulant medication usage in addition to the dependent variables listed previously.

Setting

The setting for this study is a Level 3 trauma center located in a 250-bed urban hospital in a coastal resort area in the mid-Atlantic region of the United States. This ED treats approximately 52,000 adult and pediatric patients annually. In 2017, 1,450 trauma patients were treated, 594 of whom were 65 years of age or older.

Sample

Qualifying GTPs treated in this ED between April 2014 and March 2016 were divided into two groups: those who met Delta Alert criteria, previously defined in the introduction, during the first year of the protocol and those who would have met Delta Alert criteria during the prior year had it existed. Although the second cohort of patients was not "alerted," patient data were recorded in the trauma registry on the basis of the MOI and diagnosis. A review of the trauma registry yielded 125 patients in the Delta Alert cohort and 62 patients in the pre-Delta Alert cohort. Only patients who met Delta Alert criteria during those 2 years were included in the review. Geriatric trauma patients who met higher-acuity-level alpha (unstable patients with life-threatening injuries) or bravo (stable patients with significant MOI) alert criteria and those who presented with less severe injuries not meeting alert criteria were excluded from this study.

DATA ANALYSIS

Statistical analysis was conducted using IBM SPSS version 24. Initially, testing was conducted to determine sample similarity between the cohorts. Sample homogeneity was determined by comparing the cohorts by age and ISS. The age range of the Delta Alert cohort was 65–98 years with a mean of 82.58, and the age range of the pre-Delta cohort was 65–97 years with a mean of 82.63. An independent-samples *t* test showed no significance difference in mean age between the cohorts ($t_{185} = -0.034$; $p = .973$). Likewise, ISSs were evaluated. The Delta-cohort ISS ranged from 1 to 29 with a mean of 6.8, and the pre-Delta ranged from 1 to 17 with a mean of 7.67. An independent-samples *t* test showed no significance difference in mean ISS between the cohorts ($t_{185} = -1.457$; $p = .709$). After determining cohort similarity, independent sample *t* tests were run to determine statistical differences in outcomes between the cohorts.

Mechanism of injury data are listed in Table 1, and in both cohorts, ground-level falls were the leading MOI, followed by motor vehicle crashes (MVCs). Falls of less than 20 ft. and low speed MVCs without ejection are mechanisms of injury that fell below the threshold criteria for trauma alert before the institution of the Delta Alert. The most common admitting diagnosis for the pre-Deltas was hip/femur fracture ($n = 25$), followed by closed head injury (CHI; $n = 8$), which is opposite of Delta Alert patients who presented with CHI ($n = 26$) more often than hip/femur fractures ($n = 16$). The most common anticoagulant medication for each group was warfarin (Coumadin), 43.7% of Deltas and 31.7% of pre-Deltas, followed by clopidogrel (Plavix; 31.7% of Deltas and 30.2% of pre-Deltas). Factor Xa inhibitors accounted for 19% of Deltas and 14.4% of pre-Deltas anticoagulant medication and the remainder were on heparin or enoxaparin (Lovenox) and were admitted from skilled nursing facilities (SNFs). Patient residence status upon admission is compiled in Table 2.

TABLE 1 Mechanism of Injury

Mechanism of Injury	Delta Alerts	Pre-Delta Alerts
Ground-level fall	68 (54%)	26 (42%)
Fall out of bed	10 (8%)	6 (9.6%)
Fall in bathroom	4 (3%)	4 (6%)
Fall out of chair or wheel chair	4 (3%)	4 (6%)
Fall down stairs	11 (8.8%)	5 (8%)
Fall off structure/ladder/roof	3 (2.4%)	4 (6%)
Total falls	100 (80%)	49 (79%)
Motor vehicle crash	17 (13.6%)	8 (12.9%)
Auto versus pedestrian	4 (3%)	1 (1.6%)
Auto versus bike	3 (2.4%)	1 (1.6%)
Assault	1 (<1%)	2 (3%)
Watercraft accident	0	1 (1.6%)
	n = 125	*n* = 62

RESULTS

Length of Stay

Emergency department length of stay and time to OR improved following the institution of the Delta

TABLE 2 Patient Residence Status Upon Admission

Residence Status	Delta Alerts	Pre-Delta Alerts
Home	102 (81.6%)	52 (83.8%)
Assisted living	15 (12%)	6 (9.7%)
Skilled nursing facility	8 (6.4%)	4 (6.5%)
	n = 125	*n* = 62

Alert protocol. The mean ED LOS dropped from 5.8 hr pre-Delta to 4.5 hr with Deltas and an independent-samples t test showed significance ($t_{185} = -3.327$; $p = .007$). Likewise, hospital LOS showed significance as well, $t_{119} = 0.615$; $p = .023$; however, LOS actually increased with the Delta Alert cohort. Sixty Delta alert and 61 pre-Delta alert patients were admitted with the mean LOS increasing from 4.4 days for the pre-Delta cohort to 4.8 days for the Delta cohort.

Time from ED to admission to OR was compared in the 18 Delta Alert and 32 non-Delta Alert patients who required surgery. Results from the independent-samples t tests did not show significance, $t_{48} = 1.663$; $p = .103$; however, the mean time to OR for pre-Delta Alerts was much shorter at 31.4 hr than was the mean time for the Delta Alert patients at 47.4 hr.

Admission Rate and Discharge Disposition

With the implementation of the Delta Alert, admission rate to the hospital was drastically reduced. Before instituting the Delta Alert protocol, only one patient (1.6%) meeting alert criteria was discharged directly from the ED (98.4% admitted), but after implementation of the protocol, 48 (38.1%) of the Delta Alert patients were discharged directly from the ED (61.9% admitted).

Patient discharge dispositions either directly from the ED or after hospitalization are noted in Table 3. These data highlight the successful return of GTPs to their residence of origin since the institution of this protocol—76.8% of Delta Alert patients were discharged from the ED or the hospital to their residence of origin compared with 30.6% prior to institution of this protocol. Likewise, admission to SNFs and inpatient rehabilitation showed a significant improvement from 67.7% prior to the Delta Alert protocol to 18.4% after the protocol began.

Mortality and Complications

Implementation of the Delta Alert protocol did not improve mortality; however, complication rates for GTPS were reduced. The Delta Alert cohort had a higher mortality rate than the pre-Delta cohort 4.8% compared with 1.6%.

Complication rates including deep vein thrombosis, catheter-associated urinary tract infection (CAUTI), central line blood stream infection, pressure ulcer, respiratory failure, and health care–associated infection were calculated for admitted patients in both cohorts and appear in Table 4. The pre-Delta cohort had a complication rate of 16.4% whereas the complication rate of the Delta cohort was 1.6%. An independent-samples t test to determine differences in complication rates showed statistical significance ($t_{126} = 3.092$; $p = .002$).

DISCUSSION

The results of this study show that deliberate, focused, and expedited care of the GTP improves patient outcomes, return to home rates, and quality of life after unanticipated trauma visits. The Delta Alert process front-loads the evaluation and resuscitation of the patient on arrival to the ED. By fast-tracking the needed radiology and laboratory testing, patient injuries are identified and appropriate surgical/medical consultations are initiated. More patients are directly treated and released from the ED. For those patients requiring admission, the appropriate nursing unit is identified earlier, thus decreasing ED LOS.

Length of Stay

The increase in hospital LOS with the Delta Alert cohort can be partially attributed to the ISS of three outliers who had lengthy hospital stays because of the severity of their neurological trauma and subsequent deaths. In addition, within the Delta Alert cohort, three patients were admitted for sepsis and three more for cardiac diagnoses, and all required treatment for their medical conditions prior to treatment of their injuries. When removing the outliers from calculations, the hospital stays for both operative and nonoperative patients were similar, which is to be expected on the basis of reimbursement and standards for admission and discharge criteria.

TABLE 3 Patient Discharge Disposition

Patient Discharge Disposition	Delta Alerts	Pre-Delta Alerts
Discharged home	86 (68.8%)	16 (25.8%)
Returned to assisted living	5 (4%)	0
Returned to SNF	5 (4%)	3 (4.8%)
SNF/Inpatient rehabilitation	23 (18.4%)	42 (76.7%)
Morgue	6 (4.8%)	1 (1.6%)

Note. SNF = skilled nursing facility.

TABLE 4 Complications

Complications	Delta Alerts	Pre-Delta Alerts
DVT	1	2
CAUTI	0	6
Respiratory failure	0	1
HAI (c-diff)	0	1
	1 of 67 admitted patients (1.6%)	10 of 61 admitted patients (16.4%)

Note. CAUTI = catheter-associated urinary tract infection; DVT = deep vein thrombosis; HAI = health care–associated infection.

Time to OR

An increase in time to OR for the Delta cohort surprised the research team. After further data examination, six delta alert patients were found to have a primary admitting diagnosis that was medical rather than trauma related. Priority care for those patients required treatment of their medical conditions before orthopedic repair. No patients in the pre-Delta group had a medical diagnosis as their primary admitting diagnosis. When correcting for the six patients who presented with falls requiring surgical intervention but were diagnosed and admitted for urosepsis ($n = 3$, OR delayed 7 days each), acute myocardial infarction ($n = 2$, OR delayed 72 hr), and pacemaker failure ($n = 1$, OR delayed 48 hr), time to the OR between the cohorts was lower for the Delta group (25.1 hr vs. 31.4 hr) but not found to be statistically significant ($t_{42} = -0.986$; $p = .330$).

Although mean time to OR improved when removing outliers, that improvement was not statistically significant. This is not surprising in this age group because, unless emergent operative intervention was required, patients typically had comorbidities that required medical clearance before being taken to the OR. Our institution has set a priority for door to OR time for all patients requiring femur/hip repair regardless of their alert status. This initiative focused on prompt preoperative screening and quicker access to the OR. Geriatric trauma patients have a decreased ability to adapt to illness and stress. Alterations in physical function impact all body systems increasing complication rates including pneumonia and skin breakdown, and confusion especially when bedridden, which in turn inhibits their recovery and return to preinjury capacity (Urden, Stacy, & Lough, 2014). By fast-tracking patients to the OR, we expedite postoperative physical therapy initiation and quicker discharge to home or rehabilitation care as the situation dictates.

Discharge Disposition

The outcome measure showed that the most drastic improvement was return to home in the Delta Alert population. The improvement from 31% to nearly 77% being discharged to their prior home setting shows that these patients left in a better state of health, which should result in improved quality of life. Our facility provided extensive education to the emergency medical services (EMS) agencies about GTP triage, the new protocol, and appropriate transportation to the trauma center. Emergency medical services agencies made a concerted effort to identify and reroute these patients to our location rather from going to other community hospitals. The year prior to the Delta Alert protocol, our facility received nine transfers (14.5% of the GTPs who would have met criteria) for treatment. Upon instituting the protocol, no transfers were received from community facilities. The proper identification and prompt treatment of the GTPs could account for their improved return to home rates.

Mortality and Complications

The mortality rate of the Delta Alert cohort was higher than that of the pre-Delta cohort. Although this finding was surprising, the difference in ISS for 3 of the Delta Alert patients likely accounts for the difference. Although the mean ISS showed equal variance, the highest ISS in the pre-Delta Alert cohort was 17. Of the 125 Delta Alert patients, 122 had ISS of 17 or less; however, three patients had ISS of 25 or more. When comparing patients with ISS ranges from 1 to 17 in both groups, the mortality rates are similar at 1.6% ($n = 1$) for pre-Delta alert patients and 2.4% ($n = 3$) for Delta alert patients.

The outlier patients were appropriately triaged on the basis of their presentation to EMS but after admission to the ED required endotracheal intubation and intensive care unit admission to manage their expanding intracranial bleeds. Based on these patients' ages and comorbidities, the interprofessional team, in consultation with the families, opted to forgo operative treatment and in one case to withdraw life support.

On the contrary, there was a significant improvement in complication rates. Compilations decreased from 16.4% pre-Delta to 1.6% for the Delta cohort. The most notable reduction was in the number of CAUTIs. A hospital-wide initiative to decrease indwelling urinary catheter use was likely a key factor in the reduction of urinary tract infections.

Although this study is limited in that it represents only one facility and does not track patient's return to the ED or readmissions to the hospital, it shows significant improvement in initial GTP outcomes. Hospitals & Health Networks (2014) reported that hospital where GTPs are fast-tracked had lower M&M than other hospitals. In addition, those with GTP protocols report reduced time from ED admission to OR and fewer postoperative complications and, therefore, shorter hospital stays. Focused, time-sensitive care improved patient outcomes and increased the number of patients who regain their preinjury quality of life.

IMPLICATIONS FOR PRACTICE AND RESEARCH

This study provides implications for practice in both trauma and nontrauma settings. Within the trauma

setting, centers should consider broadening alert criteria for GTPs, especially those taking anticoagulants. Geriatric patients who sustain falls and injuries are often treated outside of the trauma setting. Implications for practice include expediting care for GTPs who present with ground-level falls with injuries. Early identification of injuries and prompt treatment improve patient outcomes. Replication of this study could be undertaken at institutions that expand GTP criteria. Expansion of this or similar studies could include tracking patients for 30-day ED and/or hospital readmission due to complications from the trauma or treatment.

CONCLUSION

The GTP population merits discriminating attentiveness in the trauma setting based on its decreased physical reserve and increased risk for complications. The implementation of a trauma alert protocol specifically targeting those GTPs who do not meet previously established institutional trauma alert criteria yielded improved patient outcomes at this institution. Protocol success should not be measured solely on mortality rate but should focus on supporting GTPs' recovery to their previous level of independence. Therefore, the increased number of patients who returned to their homes and regained their pretrauma quality of life and level of independence is the most significant success that we attribute to implementation of the Delta Alert protocol.

KEY POINTS

- Because of their decreased physical reserve and increased risk of complications, the GTP population heightened awareness by emergency department staff.
- Implementation of the an additional trauma protocol specifically targeting high-risk GTPs who do not meet prior alert criteria and were at risk for poor outcomes improved patient treatment times and outcomes and decreased patient complications.
- Following the institution of the expanded GTP alert protocol, the percentage of GTPs who returned to their home setting directly from the hospital increased from 30.6% to 76.8%.

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