ORIGINAL ARTICLE

The geriatric polytrauma: Risk profile and prognostic factors

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ABSTRACT

BACKGROUND: In the German population, the percentage of elderly patients is increasing, and consequently there are more elderly patients among trauma cases, and particularly cases of polytrauma. The aim of this study was to present clinical results and a risk profile for geriatric polytrauma patients.

METHODS: Review of 140 geriatric (over 65 years of age) polytrauma patients who received prehospital treatment was performed. Severity of trauma was retrospectively assessed with Hannover Polytrauma Score (HPTS). Age, hemoglobin (Hb) level, systolic blood pressure (BP), Glasgow Coma Scale (GCS) score, timing of and necessity for intubation were analyzed in relation to mortality and in comparison with younger patients.

RESULTS: Geriatric polytrauma patients (n=140) had overall mortality rate of 65%, whereas younger patients (n=1468) had mortality rate of 15.9%. Despite equivalent severity of injury (HPTS less age points) in geriatric and non-geriatric groups, mortality rate was 4 times higher in geriatric group. Major blood loss with Hb <8 g/dL was revealed to be 3 times more fatal than moderate or minor blood loss (Hb ≥8 g/dL). GCS score <12 corresponded to double mortality rate (39% vs 83%).

CONCLUSION: Age by itself is significant risk factor and predictor of increased mortality in polytrauma patients. Additional risk factors include very low GCS score and systolic BP <80 mm Hg, for instance, as potential clinical indicators of massive bleeding and traumatic brain injury. Such parameters demand early and rapid treatment at prehospital stage and on admission.

Keywords: Geriatric polytrauma; Glasgow Coma Scale; Hannover Polytrauma Score; polytrauma.

INTRODUCTION

Percentage of elderly patients in the German population continues to grow. Consequently, there are more elderly patients among all trauma cases, especially as the elderly are more active now than former generations were.[1,2] Elderly polytrauma patients constitute special case due to reduced compensatory mechanisms and resources.

In the present study, data of 140 trauma patients with minimum age of 65 years were analyzed. Severity of trauma was assessed using the Hannover Polytrauma Score (HPTS), as this score includes age as an additional criterion that influences outcome.

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MATERIALS AND METHODS

The study included 1608 polytrauma patients who underwent prehospital emergency treatment in Franconia, Germany. All patients were treated by single emergency department. Patients were divided into 2 groups: polytrauma patients below 65 years of age, and those 65 and over (geriatric patients). HPTS, Glasgow Coma Scale (GCS) score, hemoglobin (Hb) level at admission, score on shock index described by Allgöwer and Buri, and pupil status at trauma location were analyzed in order to determine severity of polytrauma.

RESULTS

Of 1608 polytrauma patients, 140 (8.7%) were 65 years of age or older. HPTS score, used to assess severity of trauma, quantifies injuries in 5 anatomical regions (skull, thorax, abdomen, extremities, and pelvis) and adds point value for different age groups. HPTS accounts for multiple injuries in single

anatomical region, which is a significant advantage over other scoring systems. Expected mortality rate increases with higher score values (Table 1).

Geriatric trauma patients had mean score of 41.1 and overall mortality rate of 65%, whereas younger patients had score of 27.4 and mortality rate of 15.9%. This is 4-fold higher mortality in elderly patients. Table 2 demonstrates HTPS in 5 subgroups without age points. Severity of injury was comparable in all geriatric subgroups, as well as comparable to younger group (HPTS of 27.4).

More than half of the patients (52.9%) were between 65 and 74 years old (Groups 1 and 2). Mean HPTS score was only slightly higher than that of younger group (39.9 vs 32.9). Groups 3 and 4 (75–84 years) represented 40% of all trauma patients. This population had significantly ($p<0.001$) higher HPTS score (47.2 vs 35.9), as well as higher mortality than Groups 1 and 2 (61.8% vs 36.4%). Only 8% of polytraumatized patients (Group 5) were 85 years of age or older. Ten of 11 died as result of injuries (90.9% mortality).

When age points were subtracted from HPTS score, it was observed that score values were nearly identical between geriatric group and younger group (<65 years). This shows crucial influence of old age on prognosis.

Blood loss prior to admission also had noticeable effect on outcome (Table 3). Mortality on day of admission was below 10% if there was no significant blood loss (Hb ≥12g/dL). Minor blood loss (Hb 8–11.9 g/dL) resulted in mortality rate twice as high, and two-thirds of the patients with major bleeding (Hb <8 g/dL) died on day of injury.

Influence of blood loss on prognosis was also demonstrated in subgroup of patients with abdominal trauma. Abdominal trauma is most common reason for massive bleeding and hypovolemic shock. Mortality rate increased to 27% in the 633 of 1608 patients with intraabdominal bleeding source, in contrast to 16% in remaining 974 trauma patients without abdominal injury. This increase in mortality can be directly explained by correlating HPTS scores. Patients with intraabdominal bleeding had mean score of 35, while those without intraabdominal bleeding had score of 25.

In geriatric group, overall mortality rate of 60% was observed in cases of intraabdominal bleeding, compared with 36% among those without abdominal injury.

Extent of blood loss correlated with injury severity (Table 4). Patients with Hb <8 g/dL had mean HPTS of 35; patients with Hb >12 g/dL had mean HPTS of 18.

Another striking relationship was seen between blood loss and GCS score. Massive bleeding (Hb ≤8 g/dL) correlated with low mean GCS score of 6.3, in contrast to GCS score of 11.2 among those with Hb >12 g/dL (Table 5). It was concluded that GCS, which primarily classifies severity of trau-

Table 1. TTrauma severity/Hannover Polytrauma Score/ expected mortality

Severity	Score value	Expected lethality
Grade I	0–11	<10%
Grade II	12–30	<25%
Grade III	31–49	<50
Grade IV	>49	75%

Table 2. Age group / HPTS / lethality

Groups	Age	HPTS	HPTS – age points	Hospital lethality
Group 1	65–69	33.7	25.7	35.9%
Group 2	70–74	38.1	25.1	37.1%
Group 3	75–79	47.3	26.2	66.7%
Group 4	80–84	47.4	26.4	56.0%
Group 5	>85	45.2	24.4	90.9%

HPTS: Hannoverian Polytrauma Score.

Table 3. Hemoglobin / lethality

Hemoglobin (g/dL)	Lethality (%)
<8 g/dL	62.5%
8–11.9 g/dL	22.0%
≥12 g/dL	9.7%

Table 4. Hemoglobin / HPTS / HPTS + age points

Hemoglobin (g/dL)	HPTS (HPTS + age points)
≤8.0	35 (51)
8.1–9.9	28 (43)
10.0–11.9	25 (40)
≥12	18 (33)

HPTS: Hannoverian Polytrauma Score.

Table 5. Hemoglobin / Glasgow Coma Scale

Hemoglobin (g/dL)	Glasgow Coma Scale points
≤8	6.3
8.1–9.9	9.2
10.0–11.9	10.3
≥12	11.2

Table 6. Glasgow Coma Scale / Lethality rate

Glasgow Coma Scale points	Lethality (%)
3–7	82.6
8–12	84.6
13–15	39.3

Table 7. Hemoglobin / Shockindex (SI)

Hemoglobin (g/dL)	≤8	8.1–9.9	10.9–11.9	≥12
Shockindex	1.14	0.87	0.87	0.68

matic brain injury (TBI), can also indicate severity of reduced cerebral perfusion caused by hypovolemia.

GCS score below 12 was associated with mortality rate twice as high (39% vs 83%), which clearly indicates influence of GCS score on prognosis (Table 6).

Shock index introduced by Allgöwer and Buri, defined as heart rate divided by systolic blood pressure (BP) and used to grade severity of shock, proved to be less reliable predictor. In the present study, only patients with Hb <8 g/dL demonstrated pathological shock index score (Table 7).

Assessment of pupil status provided relevant information about outcome. Trauma patients with pupils of equal size or normal pupil reaction were found to have mortality rate of 43.6%, whereas patients with pathological pupil reactions (dilated pupils, pupils of unequal size) had higher mortality (87.2%). Of 16 patients with bilaterally small pupils, only 1 survived (93.8% mortality).

Patients with pathological pupil reaction frequently had decreased level of consciousness. Only 15% had normal orientation and 70% had primary or secondary loss of consciousness. In contrast, normal orientation was observed in 50% and primary or secondary unconsciousness in only 26% of the patients with normal pupil reaction.

Necessity for urgent intubation proved to be important risk factor. Majority of patients (41.2%) had to be intubated at site of injury, and that group had worst outcomes, with mortality rate of 83%. It was also determined that group had lowest GCS score (mean: 5.8). Patients who did not require intubation or ventilation had mean GCS score of 14.3 and mortality rate of 37.1% (Table 8). Survival rate decreased with earlier necessity to intubate.

Decision to intubate urgently was influenced by severity of trauma, as in case of lung contusion, for example. Patients requiring intubation had 7-point higher HPTS with age factor excluded (Table 9).

Total of 7% of all trauma patients died in resuscitation area. This group had worst injury score (HPTS: 58.8; HPTS-age factor: 42.1), lowest GCS score (6.7), and lowest Hg level (6.6 g/dL), as well as lowest systolic BP (68.8 mmHg).

Of the 32.6% of patients who required emergent operation, 59.5% died. Those patients had mean HPTS of 45.6 and HPTS-age factor of 31.0, GCS score of 9.4, Hg level of 9.8 g/dL, and systolic BP of 106 mmHg.

In this context, systolic BP on admission is of particular importance. Four-fold higher mortality rate was detected in all polytrauma cases (n=1608), including geriatric polytrauma cases, when BP was below 80 mmHg upon arrival to hospital. Most common injuries were to head and brain (76%), followed by thoracic trauma (66%), and fractures of upper (45%) and lower extremities (53%). Abdominal and pelvic injuries each occurred in 28%, and spinal column injuries in 16%.

Abdominal trauma as sole injury had very poor prognosis. This type of injury was observed twice as often in patients who exited (35.3% vs 19.6%). As mentioned previously, mor-

Table 8. Time of intubation / lethality / Glasgow Coma Scale

	Trauma site	During transport	In hospital	No intubation
Lethality	83.0%	75.0%	64.5%	37.1%
Glasgow Coma Scale	5.8	6.5	12.2	14.3

Table 9. Time of intubation / severity of injury

	Trauma site	During transport	In hospital	No intubation
Hannoverian Polytrauma Score	43.0	44.1	48.7	32.7
Hannoverian Polytrauma Score-age factor	27.1	26.9	31.9	19.8

Table 10. Thoracic injuries / lethality (%)

Heart	100
Major thoracic vessels	100
Hematothorax	60.9
Pneumohematothorax	55.6
Parenchyma of the lung	55.0
Ribfracture	47.9
Pneumothorax	33.3

tality rate of 60% was detected in cases of intraabdominal bleeding with another concurrent injury, in contrast to only 36% in cases without abdominal bleeding.

Another high-risk injury proved to be pelvic fracture. Massive bleeding caused by this injury occurred nearly twice as often in patients who died (31.8% vs 21.7%). This additional injury led to dramatic increase in mortality in the geriatric subgroup (78%) compared to 24% in the non-geriatric patients (≤64 years).

Additional injury to the head and brain, or TBI, or to the thorax resulted in especially unfavorable outcome. Total of 80% of the patients who died on day of injury had concomitant injury of the head and brain or the thorax. Overall mortality rate was 82.4% with TBI and 65.9% with thoracic injury. In all, 106 patients (76.4% of the geriatric patients) suffered from 152 single injuries of the head and brain. In case of grade I TBI (concussion), mortality was 25%. However, mortality increased significantly in grade III TBI: Basal skull fracture had mortality rate of 47.4% and calvarial fracture had mortality rate of 64.3%. In event of intracerebral bleeding, mortality was above 70%.

In the present study, 92 trauma patients had total of 144 thoracic injuries (Table 10). High in-hospital mortality rate of 60.9% in case of hematothorax is notable. All patients with either rupture of the heart (n=2) or major thoracic vessels (n=5) died instantly.

Approximately 30% of our geriatric patients survived their extensive injuries in the long run. During follow-up period (mean: 9.3 years), 16 patients (11.4%) died of non-injury-related causes. Remaining 25 patients were without major health problems at time of data collection (only 2 were in need of professional care).

DISCUSSION

Polytrauma poses special challenge at all ages due to imminent life-threatening circumstances and limited therapeutic window. Reduced physiological reserves as well as primarily reduced organ function demonstrate why increased demand in trauma (for example, elevated endogenous vasopressor level in case of shock) often cannot be met sufficiently in elderly patients.[3–16] This pathophysiological restriction is demonstrated in increased mortality with greater age.[5,8,9,12,17–27] In the present study, 4 times greater mortality was determined in the geriatric group compared with the younger patient group (65% vs 15.9%).

Direct correlation has been noted between increase in mortality and greater injury level in several publications.[14,22,26,28–32] Our data confirm correlation, revealing significantly increased mortality rate corresponding to elevated injury score: Patients older than 75 years of age had highest HPTS and highest mortality rate.

We conclude that age alone constitutes substantial risk factor. Removal of age factor from total HPTS in all groups revealed nearly identical score values. HPTS was approximately 25 points in all groups (Table 1). Result highlights fact that geriatric trauma patients need rapid and appropriate prehospital evaluation and initiation of therapy in order to prevent fatal course of events.[3,9,14,33–39]

Hypovolemic shock plays central role in bad outcome and increased mortality rate[8,9,12,20,25,28,40–43] as seen in our patients with massive bleeding. It was determined that additional intraabdominal bleeding doubles mortality rate (Table 2, 9).

Necessity for blood transfusion in case of massive bleeding reveals hypovolemic shock as crucial factor in increased mortality.[32,44] Mortality was 25% when <20 blood units were transfused, and 56% if >20 blood units were necessary for hemodynamic stabilization. In the event of massive transfusion, coagulopathy and derangement of acid-base homeostasis are often seen. Simultaneous hypothermia amplifies coagulopathy and leads to ongoing bleeding[3,28,40,44] Pathological blood coagulation parameters measured on admission lead to increased mortality in all polytrauma cases compared with those who have normal coagulation parameters (25.7% vs 6.5% mortality rate).

In geriatric polytraumatized patients we generally assume preexisting arteriosclerosis with consequently limited vascular tonus and reduced cardiac reserves, which can lead to rapid cardiovascular decompensation if hypovolemia develops.[3,5,6,18,20,21,33–36,38,39,45,46] Volume resuscitation as soon as possible should raise systolic BP to at least 80 mmHg. In case of concomitant head and brain injury, systolic BP should even be at least 120 mmHg in order to maintain adequate cerebral perfusion and to prevent secondary brain injury.[3,9,28,43] Systolic BP is important preclinical parameter, especially for managing volume resuscitation. If necessary, hyperosmotic solutions (e.g., HyperHaes 250 ml; Fresenius Kabi Deutschland GmbH, Bad Homburg v.d.H., Germany) should be used to raise BP rapidly in event of hemodynamic instability. If systolic BP was below 80 mmHg on admission, 4-fold increase in mortality was seen compared with trauma patients with systolic BP above 80 mmHg.

Unfortunately, shock is often noticed too late or underestimated because obvious signs of shock (e.g., tachycardia and/or low BP) may be delayed.[27] Beta blockers, for example, suppress reflex tachycardia, and normal BP level may in fact be pathological for patient with untreated hypertension. Negative chronotropic effect of beta blockers leads to impaired cardiac output and may therefore be especially harmful.[12]

The often-quoted shock index did not prove to be reliable predictor in our study (Table 6). In order to prevent diagnostic pitfalls, we recommend use of capillary refill time (pathological if >2 seconds) and GCS. GCS is of major prognostic relevance (Table 5), especially in relation to head and brain injuries.[3,8,15,16,23,25,29,32,35,42–44,47–49] Additionally, it allows for reproducible preclinic evaluation to determine necessity of intubation. It also provides evidence on possible volume deficit, which can lead to reduced cerebral perfusion and consequently to impaired or loss of consciousness (Table 4).

Our data as well as other studies indicate that head and brain injuries and thoracic traumata are major risk factors,[3,9,13,18,50,26–28,40] and co-occurrence leads to exponential increase in mortality. Already limited pulmonary reserves[3,5,6,9,23] may be further reduced by trauma. For example, lung contusion may rapidly lead to hypoventilation and hypoxia, and can cause secondary brain injury. Therefore, liberal indication for intubation and ventilation with 100% oxygen is recommended.[3,20,33,35]

Sufficient anesthesia achieves best possible management of pain. As pain stimulates release of shock mediators, anesthesia can also suppress shock mediator-induced cardiovascular depression.

Early intubation was significant risk factor,[12,18,43] but primarily indicates that this group was most injured and had highest cerebral impairment (Table 8), thus requiring urgent intubation. Chest tubes (≥28-French) should be inserted early to establish adequate ventilation of the lung by draining hemato- or pneumothorax.

Pelvic fractures considerably reduce survival rates in polytraumatized patients.[3,51–55] In our study, mortality rate was 78% in geriatric group with pelvic fracture compared with 24% in younger group (≤64 years) with pelvic fracture. In this case, immediate prehospital procedures are necessary. For instance, applying pelvic belt, circumferential wrapping of the pelvis, or vacuum mattress, all of which help reduce bleeding from fractured bones.

Another measure, often disregarded, is to preserve body temperature with warmed intravenous fluid therapy, warm interior of ambulance, or warm blankets, for example. This is of great pathophysiological importance, as hypothermia leads to coagulopathy and consequently to progressive bleeding ("deadly triad").

In the elderly, limited physiological mechanisms of compensation necessitate close monitoring in prehospital stage with electrocardiogram, pulsoxymetry, and pupil reaction, and in hospital with advanced monitoring, such as invasive blood pressure and pulse contour cardiac output monitoring.[3,36,12,56] These measures are the only way to recognize life-threatening changes and intervene in time to prevent acute decompensation. Only a trauma center with appropriate modalities (resuscitation area, blood bank, blood recovery system, etc.) and experienced surgical team is able to keep high mortality within limits.[6,12,14,29,36,38,57]

Conclusion

With aid of HPTS, we were able to generate risk profile for geriatric polytrauma patients that will enable statement on prognosis even at prehospital stage. Traumatized patients with systolic BP level <80 mmHg are at high risk, as are those with very low GCS score. GCS score is not only pathologically low in event of head and brain injury, but may also decrease due to cerebral hypoperfusion due to massive bleeding. Age by itself is significant risk factor; however, this should not encourage "therapeutic lethargy." Quite the contrary, early and aggressive treatment for shock is called for, as physiological reserves in the elderly are reduced.[4,20,37–39,46] After all, nearly 30% of our geriatric polytrauma patients survived their injuries without major physical problems, with the exception of 2 who required professional care.

Conflict of interest: None declared.

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ORİJİNAL ÇALIŞMA - *ÖZET*

Geriatrik politravma: Risk profili ve prognoz faktörleri

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AMAÇ: Alman nüfusunda yaşlı hastaların oranı giderek artmaktadır. Bu sonuçla, travma ve özellikle politravma olgularındaki yaşlı hastaların oranı da artmaktadır. Bu çalışmamızın amacı, klinik bulgularımızı sunmak ve bu konuda geriatrik politravma olgularına bir risk profili oluşturmaktır.
GEREÇ VE YÖNTEM: Hastane öncesi acil girişimde bulunulan 140 geriatrik politravma olgusunu kapsayan bir çalıma yürütüldü. Travmanın şiddeti Hanover Politravma skoruna (HPTS'ye) uyularak geçmişe yönelik olmak üzere değerlendirildi. Yaş, hemoglobin, sistolik kan basıncı, Glasgow Koma Skoru, entübasyona girişim zamanı ve endikasyonu mortalite ve genç hastalarla karşılaştırmalı olarak analiz edildi.
BULGULAR: Geriatrik politravma olgularının (n=140) mortalite yüzdesi %65 olarak bulunurken, genç politravma hastalarındaki (n=1468) mortalite oranı sadece yüzde 15.9 olarak tespit edildi. İki gruptaki travma şiddeti yaklaşık olarak aynı olmasına rağmen (HPTS – yaş puanları), geriatrik hastalarda mortalite dört kat daha fazla idi. Bunun yanı sıra, ağır kan kaybı (hemoglobin <8 g/dL), orta derece ve hafif kan kaybına (hemoglobin ≥8 g/dL) oranla da dört kat daha fazla mortalite bulundu. On ikinin altındaki bir Glasgow Koma Skoru ise bu değerin üzerindeki olgulara kıyasla iki kat daha fazla mortalite göstermekteydi (%39'a %83).
TARTIŞMA: Politravma hastalarında, hasta yaşının, kendi başına anlamlı olan bir risk faktörü olduğu ve mortalite artışını önceden gösterdiği tespit edilmiştir. Buna ek olarak düşük Glasgow Koma Skoru; şiddetli kan kaybında klinik bir bulgu olan 60 mmHg'nin altındaki sistolik kan basıncı ve beyin travması, diğer risk önemli faktörlerindendir. Bu faktörler, hastane öncesi ve hastane acilinde, erken ve en kısa sürede tedaviyi gerektirmektedir.
Anahtar sözcükler: Geriatrik politravma; Glasgow Koma Skoru; Hanover Politravma Skoru; politravma.

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