

Geriatric Trauma - a rising tide. Assessing Patient Safety challenges in a vulnerable population. The GTAPS project protocol

Mathias Cuevas-Østrem, Olav Røise, Torben Wisborg, Elisabeth Jeppesen

Submitted to: JMIR Research Protocols
on: August 13, 2019

Disclaimer: © The authors. All rights reserved. This is a privileged document currently under peer-review/community review. Authors have provided JMIR Publications with an exclusive license to publish this preprint on its website for review purposes only. While the final peer-reviewed paper may be licensed under a CC BY license on publication, at this stage authors and publisher expressly prohibit redistribution of this draft paper other than for review purposes.

Table of Contents

Original Manuscript..... 5



Geriatric Trauma – a rising tide. Assessing Patient Safety challenges in a vulnerable population. The GTAPS project protocol

Mathias Cuevas-Østrem, MD; Olav Røise, MD, PhD; Torben Wisborg, MD, PhD; Elisabeth Jeppesen, PhD

Corresponding Author:

Mathias Cuevas-Østrem, MD

Phone: 91332923

Fax:

Email: mathias.cuevas-ostrem@norskluftambulanse.no

Abstract

Background: Many high- and-middle-income countries around the world are experiencing historic demographical changes: People are living longer, birth rates are decreasing, and older people constitute a growing proportion of the population. This contributes to increasing numbers of geriatric trauma patients. Geriatric patients have higher mortality rates after injury than younger patients, and many characteristics of geriatric patients are risk factors for a poor outcome after trauma, such as high age, pre-existing medical conditions, anticoagulant use, frailty and altered physiological response to trauma. While younger patients are more often injured in high-energy trauma, older patients are more often injured in low-energy trauma, e.g. same-level falls, from which they can sustain severe injury. Despite these differences most trauma systems use the same triage tools for all adults, and the elderly are found to have a high risk of undertriage. Due to the inherent risk-factors of a poor outcome and the fact that trauma systems are not sensitive enough to address these challenges, the geriatric trauma patients are vulnerable. These factors suggest that there might be a patient safety risk for geriatric trauma patients built-in to the Norwegian national trauma system.

The way health personnel and trauma systems handle geriatric trauma is only partially explored. Our aim is to assess if patient safety challenges exist for Norwegian geriatric trauma patients, to identify risk areas, and to explore differences in trauma care given to young and elderly trauma patients. This knowledge will contribute to the improvement of trauma care given to the most rapidly increasing population segment in developed countries.

Inherent trauma system challenges and patient risk factors might not be the only factors contributing to geriatric trauma outcomes. Questions have been raised about whether negative attitudes towards the elderly – ageism – might contribute to their disproportionately negative outcomes. There is a possibility that expectations of poorer outcomes lead to passive, observational roles and low treatment ambitions, which can create a self-fulfilling prophecy of bad outcomes. This dilemma will be addressed in this project.

Objective: The aim of this project is to investigate whether patient safety challenges exist for older trauma patients in Norway. An important objective of the study is to identify risk areas that will facilitate further work to safeguard and promote quality and safety in the Norwegian trauma system.

Methods: This is planned as a PhD-project divided into four parts: Three registry-based studies and one qualitative focus group study. By supplementing registry data from the Norwegian Trauma Registry (NTR) with focus group interviews with personnel in the emergency chain we will provide new knowledge about the treatment of geriatric trauma patients, knowledge that due to international trauma system similarities might be transferrable to international trauma systems.

Results: The project has received funding from January 2019 through December 2021, and it is approved by the Data Protection Officer responsible for the Norwegian Trauma Registry. An application for access to registry data has been submitted and is pending. Results will be ready for publication from spring 2020.

Conclusions: This project is the first step toward increased knowledge about trauma in Norwegian geriatric patients on a national level and will form the basis for further research aiming at interventions that eventually will make the trauma system better equipped to meet the rising tide of geriatric trauma.

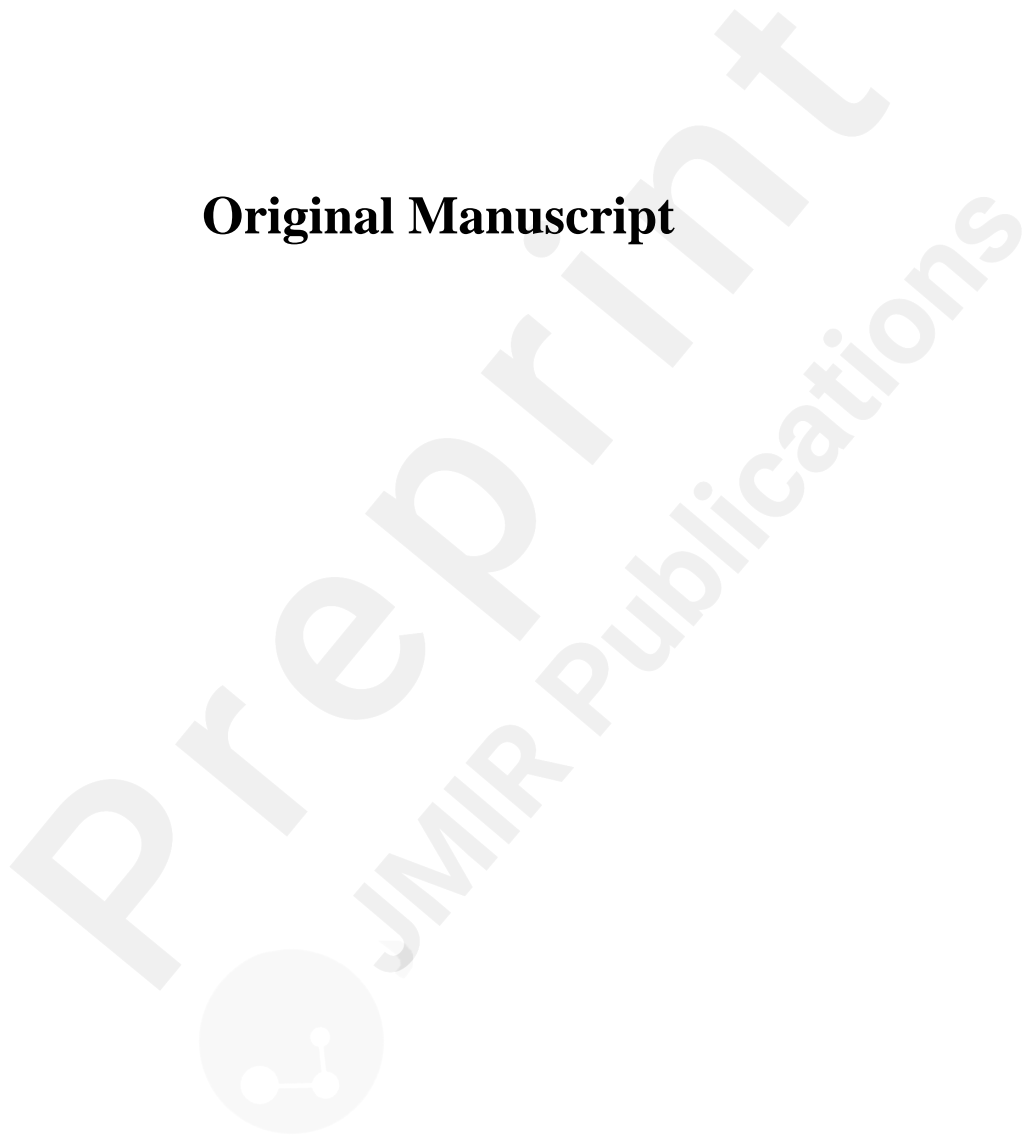
(JMIR Preprints 13/08/2019:15722)

DOI: <https://doi.org/10.2196/preprints.15722>

Preprint Settings

- 1) Would you like to publish your submitted manuscript as preprint?
 - (a) Please make my preprint PDF available to anyone at any time (recommended).
 - (b) Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.
 - ✓ (c) **Only make the preprint title and abstract visible.**
 - (d) No, I do not wish to publish my submitted manuscript as a preprint.
- 2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?
 - ✓ (a) **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**
 - (b) Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain visible to all users.
 - (c) Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in [JMIR Publications](#)

Original Manuscript



Geriatric Trauma – a rising tide. Assessing Patient Safety challenges in a vulnerable population

The GTAPS project protocol

Abstract

Background: Many high- and-middle-income countries around the world are experiencing historic demographical changes: People are living longer, birth rates are decreasing, and older people constitute a growing proportion of the population. This contributes to increasing numbers of geriatric trauma patients. Geriatric patients have higher mortality rates after injury than younger patients, and many characteristics of geriatric patients are risk factors for a poor outcome after trauma, such as high age, pre-existing medical conditions, anticoagulant use, frailty and altered physiological response to trauma. While younger patients are more often injured in high-energy trauma, older patients are more often injured in low-energy trauma, e.g. same-level falls, from which they can sustain severe injury. Despite these differences most trauma systems use the same triage tools for all adults, and the elderly are found to have a high risk of undertriage. Due to the inherent risk-factors of a poor outcome and the fact that trauma systems are not sensitive enough to address these challenges, the geriatric trauma patients are vulnerable. These factors suggest that there might be a patient safety risk for geriatric trauma patients built-in to the Norwegian national trauma system.

The way health personnel and trauma systems handle geriatric trauma is only partially explored. Our aim is to assess if patient safety challenges exist for Norwegian geriatric trauma patients, to identify risk areas, and to explore differences in trauma care given to young and elderly trauma patients. This knowledge will contribute to the improvement of trauma care given to the most rapidly increasing population segment in developed countries.

Inherent trauma system challenges and patient risk factors might not be the only factors contributing to geriatric trauma outcomes. Questions have been raised about whether negative attitudes towards the elderly – ageism – might contribute to their disproportionately negative outcomes. There is a possibility that expectations of poorer outcomes lead to passive, observational roles and low treatment ambitions, which can create a self-fulfilling prophecy of bad outcomes. This dilemma will

be addressed in this project.

Objective: The aim of this project is to investigate whether patient safety challenges exist for older trauma patients in Norway. An important objective of the study is to identify risk areas that will facilitate further work to safeguard and promote quality and safety in the Norwegian trauma system.

Methods: This is planned as a PhD-project divided into four parts: Three registry-based studies and one qualitative focus group study. By supplementing registry data from the Norwegian Trauma Registry (NTR) with focus group interviews with personnel in the emergency chain we will provide new knowledge about the treatment of geriatric trauma patients, knowledge that due to international trauma system similarities might be transferrable to international trauma systems.

Results: The project has received funding from January 2019 through December 2021, and it is approved by the Data Protection Officer responsible for the Norwegian Trauma Registry. An application for access to registry data has been submitted and is pending. Results will be ready for publication from spring 2020.

Conclusion: This project is the first step toward increased knowledge about trauma in Norwegian geriatric patients on a national level and will form the basis for further research aiming at interventions that eventually will make the trauma system better equipped to meet the rising tide of geriatric trauma.

Introduction

High- and middle-income countries around the world face the same demographical changes: people are living longer, birth rates are decreasing, and consequently elderly people constitute a rapidly growing proportion of the population [1, 2]. These elderly often live independent and active lives despite chronic diseases and frailty, and can sustain severe injury from even minor trauma [3-5]. Statistics Norway writes in their latest population projection report from 2018 that within 15 years we will for the first time have more people living in Norway older than 65 years than from 0-19 years [6]. The same report projects that by 2060 the number of Norwegians over 70 years of age will be more than doubled [6]. Consequently, the numbers of geriatric trauma patients increase, and the geriatric trauma population is described as a rising tide [7].

Trauma is one of the leading causes of mortality and morbidity worldwide and in all age groups [8, 9]. In Norway in 2016, the most common injuries across all ages occurred in the extremities (38.3 %), head (35.4 %), chest (29.5 %) and spine (24.3 %) [10]. Geriatric trauma patients have higher

mortality rates than younger patients, adjusted for the same severity of trauma, and head injury is the leading cause of death [11-13]. Risk factors associated with a poor outcome for this group include age, pre-existing medical conditions, anticoagulant use, frailty and altered physiological response to trauma [14-20]. Hence, geriatric trauma patients are a vulnerable group.

There is an evident shift in the epidemiology of major trauma: what used to be the disease of young men in high-energy accidents is now becoming the disease of elderly patients, where the primary mechanism of injury (MOI) is falling from less than two meters [21, 22]. Major trauma is usually defined using the Injury Severity Score (ISS) or New Injury Severity Score (NISS) and the most common cut-off is ISS>15 [23]. 65 years is widely used as a cut-off for defining geriatric trauma, [16, 22, 24-26].

A 2017 report from the UK Trauma Audit and Research Network (TARN) gives new and thorough insight into the characteristics of geriatric major trauma patients [22]. Some of the central findings were as follows: over 60% of trauma patients aged 70 and above are injured indoors, the head was the most commonly injured body region, older people admitted to hospitals show lower trauma team activation rate, and the grade of the most senior clinician treating the patients on arrival decreases with increasing patient age [22]. Low-energy trauma attracts little attention [5].

A geriatric trauma patient is not simply an injured old adult. Pharmacological and age-related physiological alterations in different organ systems affect the way the geriatric patient responds to both disease and injury [27]. Amongst the changes relevant for trauma care is that geriatric patients are often frail, meaning they have low physiological reserves [14], they present with a higher Glasgow Coma Scale (GCS) than younger patients with the same injury severity [28], the threshold for hypotension is suggested to be 110 mm Hg, not 90 mm Hg [29, 30], and with increased age, the use of physiology-altering medications like beta antagonists or anticoagulants increase. This might mask the severity of injury as the vital signs resemble what is considered to be within the normal-range of values for adults. As a consequence an injured elderly patient might seem less injured when standard triage tools are used, and this is reflected in the high rate of undertriage for geriatric major trauma patients [3, 31, 32]. Undertriage increases the risk of not being treated at the right level of care at the right time and can, subsequently, increase the risk of mortality [31].

Figure 1 shows the criteria for trauma team activation in the Norwegian trauma plan:

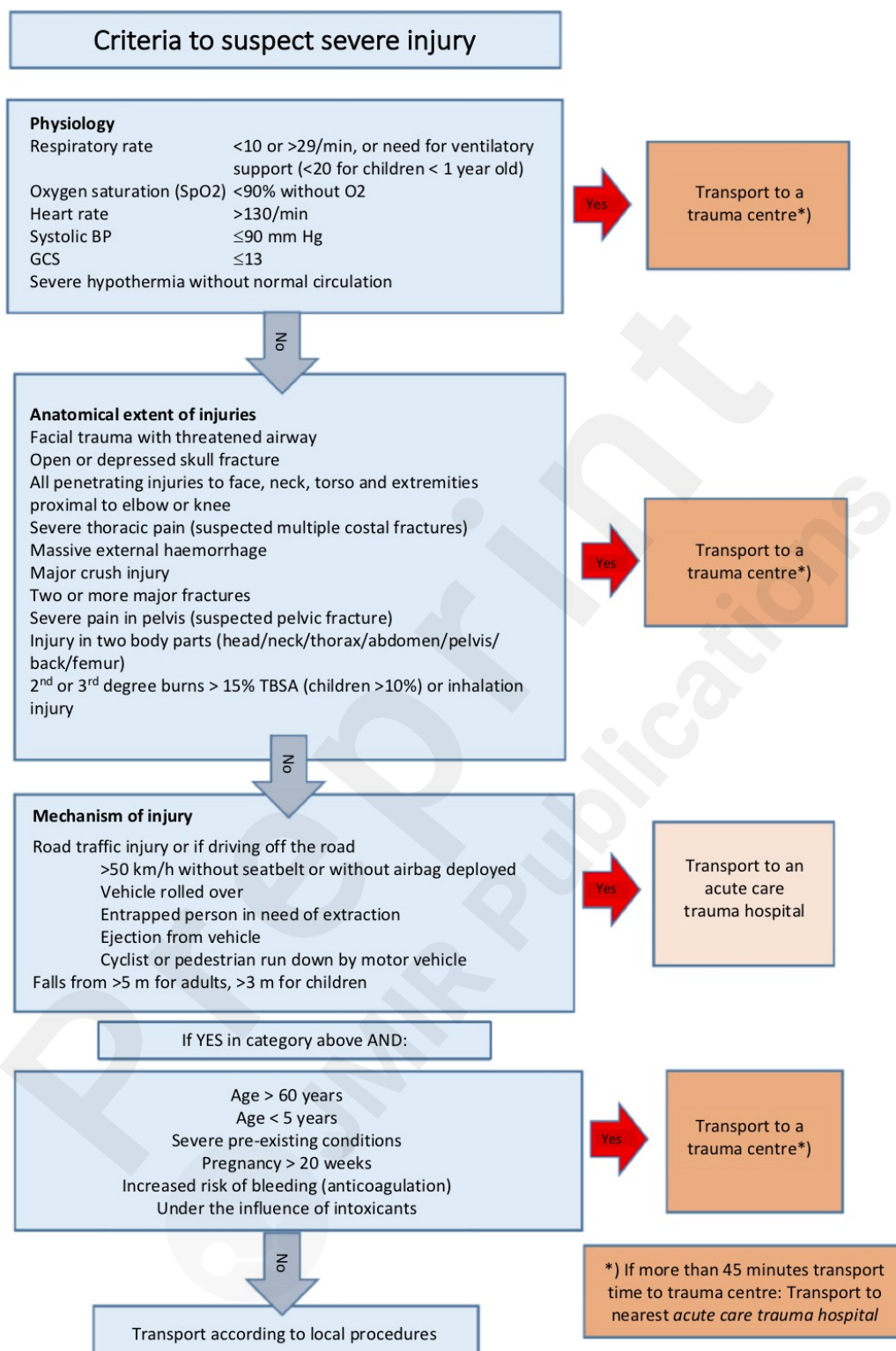


Figure 1: "Criteria to suspect severe injury" [33]

Everyone in Norway has an equal right to health care [34]. Sometimes it is, however, morally and

legally right to withdraw treatment, for example, when treatment is considered to increase suffering or not to benefit the patient [35]. Failure to treat on the basis of age alone is, however, unacceptable. As major trauma is a time-critical event, disposing the right resources at the right time without unjustifiable delay is crucial. Paradoxically, it is the elderly patients – the ones with the least physiological reserves - who get delayed treatment [22, 36, 37]. Both ATLS and the Eastern Association for the Surgery of Trauma (EAST) geriatric trauma guidelines advocate for a practice where aggressive treatment should be given until otherwise is decided [26, 38]. Early and aggressive treatment is shown to increase survival rates in older trauma patients [39-41].

Kirkman et al published a paper which raises the following central question: “Do elderly head injuries do worse because of a self-fulfilling prophecy of poorer management?” [37]. They found that the time from admission to CT head imaging and the likelihood of not being transferred to a centre with acute neurosurgical care facilities increased with age. Another study from Utter et al found that geriatric trauma patients have delayed transfer to neurocentre/level I trauma centre [36]. Little is known about which factors affect the decisions that lead to this. Negative attitudes towards elderly patients and an expectation of a poor outcome might lead to a passive, observing role and low treatment ambitions and this will be addressed in this project.

The 2016 National Trauma Plan for Norway provides requirements for all services in the national trauma system – from prehospital care to rehabilitation [33]. Norway has two hospital levels treating trauma patients; 34 acute care trauma hospitals and four trauma centres. Acute care trauma hospitals are spread out around the country and trauma centres are regional university hospitals. All acute care trauma hospitals offer general surgical and orthopaedic services and are capable of stabilizing severely injured patients before transferring them to trauma centres if necessary, but do not offer neurosurgery, intervention radiology (except for a few) and other specialized services. The trauma centres offer all medical specialties, including neurosurgery, and are capable of managing all types of injuries [42]. The annual number of patients admitted to trauma hospitals with trauma team activation (or subsequently found to have NISS above 12) in Norway is approximately 8000 and the mortality rate is 2,9% [43].

This project consists of four planned studies. Studies 1, 2 and 3 are linked to the Norwegian Trauma Registry (NTR), which will be used to identify the trauma population. Study 4 is a qualitative focus group interview study. NTR is a national quality registry which provides information on the extent

and characteristics of severely injured patients, as well as evaluates the content and outcomes of treatment. NTR has collected data since January 2015 and these data are registered from all hospitals receiving trauma patients in Norway. Inclusion and exclusion criteria are listed under Methods.

The aim of this project is to investigate whether patient safety challenges exist for older trauma patients in Norway. An important objective of the study is to identify risk areas that will facilitate further work to safeguard and promote quality and safety in the Norwegian trauma system. This will be investigated and described through four parts, study 1, 2, 3, and 4, each representing an independent project part and a subsequent publication.

Methods

Aims and objectives:

Main aim:

1. To assess if elderly Norwegian patients (>65 years) are given different emergency trauma care compared to younger patients
2. Explore explanations for potential differences in quality of trauma care between age groups in the emergency part of the trauma chain

Study setting

Study 1, 2 and 3 are registry-based studies using retrospective national data from The Norwegian Trauma Registry (NTR). Study 4 is a qualitative study using focus group interviews.

Eligibility criteria

NTR has collected national data since January 2015, registering data on the following patients:

- All patients admitted with trauma team activation (TTA)
- All patients with penetrating injury to the head/neck/torso/extremities proximal to elbow or knee.
- All patients with New Injury Severity Score (NISS) >12, and all patients with a head injury with abbreviated injury score (AIS) ≥3.
- All patients who suffered trauma-related deaths at site of trauma or during transportation to hospital, who are not referred to hospital, but where prehospital management/treatment is

initiated.

The registry excludes:

- Patients with chronic subdural hematoma.
- Patients with injuries from drowning, inhalation, hypothermia and asphyxia without concomitant trauma.

Registration: Certified registrars in each trauma hospital register all data and classify all injuries according to AIS and calculate ISS and NISS. All patients receive written information about the registry, including the opportunity to access the data recorded and deny registration. The NTR collects data from all involved hospitals as needed when patients are transferred typically from an acute trauma care hospital, to the trauma centre and later back to the acute care trauma hospital.

Patients that did not have TTA but fulfilled the inclusion criteria are important to register to ensure the completeness of data, and hence the validity and reliability of the registry. Certified registrars are aware of the importance of including these patients. Data from a master thesis showed that 50% of Norwegian trauma hospitals actively look for potentially eligible patients (Gram-Knutzen, UiS 2018).

Study overview

Study 1: Epidemiology and characteristics of geriatric trauma patients in Norway

Aim:

1. Describe the Norwegian geriatric trauma population and assess differences in demographical and epidemiological characteristics between age groups
2. Assess 30-day mortality
3. Identify injury mechanism differences between age groups
4. Assess differences in hospital admissions after trauma between age groups
5. Assess differences in the level of pre-hospital care between age groups

Hypotheses:

- Younger patients suffer primarily from injury due to high-energy trauma and elderly patients suffer primarily from injury due to low-energy trauma.
- Younger patients have higher admission rates to trauma centres than the elderly for similar

injury severity.

- Younger patients have higher transfer rates to trauma centres than the elderly for similar injury severity.

Outcome measures:

1. Primary endpoint
 - a. 30-day mortality
2. Secondary endpoints
 - a) Age, gender, mechanism of injury, blunt or penetrating trauma, AIS, ISS, NISS
 - b) Location of injury
 - c) Time from injury to admission
 - d) Transport method
 - e) Level of prehospital and in-hospital care
 - f) Interventions given prehospitally and in the emergency department
 - g) Trauma team activation
 - h) Level of care at admission and discharge
 - i) Length of stay

Study 2: Emergency interventions and radiological examinations pre-hospital and in-hospital

Aim:

1. Assess differences in the proportion of emergency interventions (pre-hospital and in-hospital airway management and pneumothorax decompression) and radiological examinations (in-hospital) performed on elderly and younger patients
2. Assess differences in pre-hospital and emergency room personnel's decision making regarding emergency interventions and radiological examinations performed on elderly and younger patients, based on vital signs

Hypotheses:

- Pre-hospital personnel use the same algorithm in decision making in both elderly and younger patients, that is; there is no discrimination in how elderly and younger patients with the same vital signs are treated
- The elderly population is expected to have same frequencies of examinations and

interventions as the younger for the same severity of injuries, both pre-hospital and in the emergency room

Methods: Analyses of data from the Norwegian Trauma Registry on pre-hospital and in-hospital vital signs, radiological examinations and emergency interventions will be used to compare age groups. The register holds information about vital signs pre-hospital and in-hospital, which radiological examination was conducted and at what time, and registered emergency interventions are advanced airway management and pneumothorax decompression.

Outcome measures:

1. Primary endpoint
 - a. Number and type of radiological examinations and emergency interventions (frequencies)
2. Secondary endpoints;
 - a. Time to examinations (x-ray; thorax, pelvis and CT)
 - b. Physiological variables

Study 3: Admission to trauma centres or acute care trauma hospitals for patients with moderate to severe traumatic brain injury (TBI)

Aim:

1. Assess differences in admission rates to trauma centre with neurosurgeon for patients in different age groups with moderate to severe TBI
2. Assess differences in transfer rates from acute care trauma hospitals to trauma centre with neurosurgeon for patients in different age groups with moderate to severe TBI
3. Assess differences between age groups in transport method (car or air ambulance), for patients with same degree of injury severity
4. Assess differences in physiological variables between age groups, both pre-hospital and at admittance (systolic blood pressure, respiratory rate, Glasgow Coma Scale score, body temperature), for patients with same degree of injury severity.

Hypotheses:

- Younger patients have higher admission rates to trauma centres than the elderly.
- Younger patients have higher transfer rates to trauma centres than the elderly.

- Younger patients are more often transported by air ambulance than the elderly.

Methods: Descriptive statistical analyses of data from the Norwegian Trauma Registry on admission rates, transfer rates, transport methods, injury severity (head AIS and GCS), demographics, patient characteristics and vital signs. Patients will be divided in groups from 18-64 and 65+ and these groups will be compared. Primary endpoint is mortality.

Regression analysis to look for predictors for increased mortality will be done, if the data allow it.

The severity of TBI can be defined using different measures. Abbreviated Injury Scale (AIS) is an international classification system defining all injury types according to severity where 1 is minor and 6 is maximal and currently untreatable. AIS >3 is recognized as moderate to severe head injury. GCS at presentation is one of the major factors directing neurosurgical decision-making, traditionally classifying TBI into mild (GCS 13-15), moderate (GCS 9-12) and severe (GCS <8). Recent evidence suggest that GCS is not as sensitive for detecting TBI in the elderly, so we will do analyses for both parameters. Also, GCS is the only measure of the two with pre-hospital value.

Outcome measures:

1. Primary endpoint:
 - a. 30-day mortality
2. Secondary endpoint:
 - a. Admission to acute care trauma hospital
 - b. Admission to trauma centre
 - c. Transfer to higher level of care
 - d. Transport methods
 - e. Physiological variables
 - f. Interventions given prehospitally and in the emergency department

Exclusion criteria: Patients admitted with a low GCS not caused by head trauma.

Study 4: Factors that may affect transfer decisions for geriatric patients with acute traumatic brain injury

Background: Traumatic brain injury is one of the leading causes of trauma-related deaths. Anti-platelet and anticoagulant drugs are frequently used in the geriatric trauma population, a risk-factor

for acute intracranial bleeding following head injury. A CT head scan is needed to detect bleedings, and this can be done in all acute care trauma hospitals in Norway. In cases of moderate to severe traumatic brain injury the local acute care trauma hospital can contact the neurosurgical department in the regional trauma centre for clinical guidance and assessment of patient transfer.

Experience from clinical practice nationally and internationally show that transfer of elderly trauma patients with head injury to a neurosurgical facility from a local acute care trauma hospital is a challenge.

We believe that there are more factors than just injury, severity and national transfer criteria that determine whether patients are transferred from an acute care trauma hospital to a trauma centre with neurosurgical facilities. We believe that possible factors are age, comorbidities, activities of daily life functions, prognosis, limitations in ward capacity, limitations in what neurosurgical intervention can offer to improve prognosis, limited time before it is too late to intervene, etc. But possibly also culture, priorities and ageism.

Aim: The aim of this study is to explore factors that may affect transfer decisions for geriatric patients with traumatic brain injury (TBI).

Methods: Focus group interviews with a purposive sample of personnel in the trauma chain relevant for this group of patients;

- a) trauma team leaders responsible for trauma patient care in acute care trauma hospitals (initial evaluation and responsible for the patient if not transferred)
- b) neurosurgeons in trauma centres (responsible for making decisions on accepting the patient for transfer or not, all neurosurgical interventions, monitoring and care in a neurosurgical ward)

The different groups will be interviewed separately (mono-professional) and will be recruited using a combination of snowball sampling method and convenience sampling. All participants will receive written and oral information about the purpose of the study. We will also obtain informed consent. Before starting the interview, they will be informed that they are discussing factors affecting transfer-decisions in a geriatric TBI population. The interviewer will use an interview guide with open-ended questions to ensure that the subjects are covered. It will cover themes such as priorities and ethical considerations, patient-related factors emphasized in the decision-making process, guidelines,

attitudes and culture, and interventions.

Criteria we seek to achieve to get a purposive sample:

A priori it is estimated that eight focus group interviews will be sufficient, but data acquisition will continue until saturation is reached. We will recruit participants for two focus groups from all four health regions, one group of team leaders and one group of neurosurgeons, to be able to say something about regional differences.

- a) Local acute care trauma hospital team leaders: Registrars or consultants with more than one-year experience as a trauma team leader and trained in the Advanced Trauma Life Support (ATLS) principles. The subjects should preferably have experienced at least one case of a geriatric trauma patient where head injury was the main reason for discussing transfer.
- b) Neurosurgeons in trauma centres: Registrars or consultants with more than one-year experience in on-call decision-making assessing patients for transfer to their respective hospitals.

The interviews will be audio-recorded and transcribed. The data found in the interviews will be categorized and analysed using systematic text condensation as described by K. Malterud [44]. This pragmatic method is developed from Giorgi's psychological phenomenological analysis but is practicable without thorough philosophical knowledge. It is systematic and consist of four steps: 1) Total impression; 2) Identifying and sorting meaning units; 3) Condensation; 4) Synthesizing.

Selection and analysis

Data collection methods: All injured patients admitted to a Norwegian hospital and meeting the above-mentioned inclusion criteria for the Norwegian Trauma Registry in the period 01.01.2015 - 31.12.2018 will be included in the analysis. Exact numbers are not ready at the time of writing, but an estimated 32 000 patients will be included in total, 6800 \geq 65 years of which 2400 severely injured (NISS>9).

Data management: All data will be handled and saved in a secured data server administered by the Norwegian Air Ambulance Foundation. All data will be unidentifiable when sharing between the authors and in the analysis and presentations.

The data will be stored for 5 years from study start.

Statistical methods: The cohort of patients included in the NTR in the years 2015 through 2018 will be analysed using SPSS. Descriptive statistics as frequency, mean, median, rate and range will be used to describe the study population. Nonparametric or parametric methods will be chosen as indicated comparing data for different groups of patients (T-test and Chi-Square test). Models with several independent variables will be used to examine the effect on outcome. In addition to detailed descriptive analyses, the observational registry-based data will be analysed using appropriate multivariable models (logistic regression).

Ethical considerations

Research will be conducted according to the ethical guidelines of the Helsinki declaration. The study protocol will be sent to the Oslo University Hospital data protection officer (PVO) for approval. This project comprise analysis on de-identified data and does consequently not require approval from Regional Committee for Medical and Health Research Ethics (REC).

Results

The project has received funding by the Norwegian Air Ambulance Foundation from January 2019 through December 2021. It is approved by the Data Protection Officer responsible for the Norwegian Trauma Registry. An application for access to registry data has been submitted and is pending. Results will be ready for publication from spring 2020.

Project arrangements

The project is collaboration between the Norwegian Air Ambulance Foundation, the National Trauma Registry (NTR), Oslo University Hospital (OUH), Norwegian National Advisory Unit on Trauma (OUH) and the University of Stavanger. The project leader is professor Olav Røise MD, PhD. The study will be performed by one PhD-fellow.

Discussion

The vulnerable group of geriatric trauma patients are increasing in numbers. Given the challenges described above, there might be patient safety risks for this group in the Norwegian national trauma system, and there might be room for improvement. No study has been conducted in Norway

assessing differences in trauma care between age groups, using national data. With the rising tide of geriatric trauma fast approaching, we want to investigate differences in trauma care between age groups in the Norwegian population and evaluate if patient safety risks exist for geriatric trauma patients.

With the rising tide of geriatric trauma as a background, this research will have a societal impact. If there are differences between young and old age groups, e.g. regarding mortality, injury mechanisms, transport times, admittance and transfer rates to trauma centres, it is important to know them to make sound decisions in the future. If, for example, geriatric trauma patients are found to be systematically treated at a lower level of trauma care, it will be important to document, and the next step will be to examine why these differences exist. Findings regarding characteristics and physiological responses will possibly support international studies and be the first to assess this in the Norwegian population. In order to address this, population-based data, supplemented by qualitative research are required.

This project will provide valuable knowledge for development of the national trauma system during the demographical changes in the coming years. Due to the fact that the model of trauma care is shared internationally these findings will possibly have an impact outside of Norway.

References

1. WHO. Ageing and health [Web page]. www.who.int2018 [Available from: <https://www.who.int/news-room/fact-sheets/detail/ageing-and-health>].
2. Vincent G, Velkoff, V. The next four decades, the older population in the United States: 2010 to 2050 population estimates and projections. Washington, DC: US Department of Commerce Economics and Statistics Administration, US Census Bureau; 2010.
3. Kodadek LM, Selvarajah S, Velopulos CG, Haut ER, Haider AH. Undertriage of older trauma patients: is this a national phenomenon? *J Surg Res*. 2015;199(1):220-9.
4. Vaage O. Over 80 år og fortsatt fysisk aktiv. *Samfunnsspeilet*. 2015:3-6.
5. Bergeron E, Clement J, Lavoie A, Ratte S, Bamvita JM, Aumont F, et al. A simple fall in the elderly: not so simple. *J Trauma*. 2006;60(2):268-73.
6. Syse A, Leknes, S., Løkken S., Tønnessen M. Norway's 2018 population projections. Main results, methods and assumptions. www.ssb.no: Statistics Norway; 2018.
7. Ciesla DJ, Pracht EE, Tepas JJ, 3rd, Cha JY, Langland-Orban B, Flint LM. The injured elderly: a rising tide. *Surgery*. 2013;154(2):291-8.
8. Knudsen AK TM, Haaland ØA, Kinge JM, Skirbekk V, Vollset SE. . Disease Burden in Norway 2015. Results from the Global Burden of Diseases, Injuries, and Risk Factors Study 2015 (GBD 2015). Bergen/Oslo: Folkehelseinstituttet, 2017.
9. WHO. Injuries and violence: The facts. Internet: WHO; 2010.
10. Nasjonalt_traumeregister. Årsrapport 2016. Oslo: Oslo universitetssykehus; 2017.
11. Hashmi A, Ibrahim-Zada I, Rhee P, Aziz H, Fain MJ, Friese RS, et al. Predictors of mortality in geriatric trauma patients: a systematic review and meta-analysis. *J Trauma Acute Care Surg*. 2014;76(3):894-901.
12. Perdue PW, Watts DD, Kaufmann CR, Trask AL. Differences in mortality between elderly and younger adult trauma patients: geriatric status increases risk of delayed death. *J Trauma*. 1998;45(4):805-10.
13. Ringen AH, Gaski IA, Rustad H, Skaga NO, Gaarder C, Naess PA. Improvement in geriatric trauma outcomes in an evolving trauma system. *Trauma Surgery & Acute Care Open*. 2019;4(1).
14. Joseph B, Pandit V, Zangbar B, Kulvatunyou N, Hashmi A, Green DJ, et al. Superiority of frailty over age in predicting outcomes among geriatric trauma patients: a prospective analysis. *JAMA Surg*. 2014;149(8):766-72.
15. Wang CY, Chen YC, Chien TH, Chang HY, Chen YH, Chien CY, et al. Impact of comorbidities on the prognoses of trauma patients: Analysis of a hospital-based trauma registry database. *PLoS One*. 2018;13(3):e0194749.
16. Goodmanson NW, Rosengart MR, Barnato AE, Sperry JL, Peitzman AB, Marshall GT. Defining geriatric trauma: when does age make a difference? *Surgery*. 2012;152(4):668-74; discussion 74-5.
17. Heffernan DS, Thakkar RK, Monaghan SF, Ravindran R, Adams CA, Jr., Kozloff MS, et al. Normal presenting vital signs are unreliable in geriatric blunt trauma victims. *J Trauma*. 2010;69(4):813-20.
18. Sammy I, Lecky F, Sutton A, Leaviss J, O'Cathain A. Factors affecting mortality in older trauma patients-A systematic review and meta-analysis. *Injury*. 2016;47(6):1170-83.
19. Boltz MM, Podany AB, Hollenbeak CS, Armen SB. Injuries and outcomes associated with traumatic falls in the elderly population on oral anticoagulant therapy. *Injury*. 2015;46(9):1765-71.
20. Peck KA, Calvo RY, Schechter MS, Sise CB, Kahl JE, Shackford MC, et al. The impact of preinjury anticoagulants and prescription antiplatelet agents on outcomes in older patients with

traumatic brain injury. *J Trauma Acute Care Surg.* 2014;76(2):431-6.

21. Kehoe A, Smith JE, Edwards A, Yates D, Lecky F. The changing face of major trauma in the UK. *Emerg Med J.* 2015;32(12):911-5.
22. Banerjee J, Baxter, M., Coats, T., Edwards, A., Griffiths, R., Kumar, D.S., Lecky, F., Sammy, I., Turpin, S., Wheldon, A., Woodford, M., . The Trauma Audit and Research Network - Major Trauma in Older People 2017. Report. 2017.
23. Palmer C. Major trauma and the injury severity score--where should we set the bar? *Annu Proc Assoc Adv Automot Med.* 2007;51:13-29.
24. Grossman MD, Miller D, Scaff DW, Arcona S. When is an elder old? Effect of preexisting conditions on mortality in geriatric trauma. *J Trauma.* 2002;52(2):242-6.
25. Hildebrand F, Pape HC, Horst K, Andruszkow H, Kobbe P, Simon TP, et al. Impact of age on the clinical outcomes of major trauma. *Eur J Trauma Emerg Surg.* 2016;42(3):317-32.
26. Calland JF, Ingraham AM, Martin N, Marshall GT, Schulman CI, Stapleton T, et al. Evaluation and management of geriatric trauma: an Eastern Association for the Surgery of Trauma practice management guideline. *J Trauma Acute Care Surg.* 2012;73(5 Suppl 4):S345-50.
27. Trauma ACoSCo. Advanced trauma life support (ATLS): the ninth edition. Chicago: American College of Surgeons; 2012.
28. Kehoe A, Smith JE, Bouamra O, Edwards A, Yates D, Lecky F. Older patients with traumatic brain injury present with a higher GCS score than younger patients for a given severity of injury. *Emerg Med J.* 2016;33(6):381-5.
29. Eastridge BJ, Salinas J, McManus JG, Blackburn L, Bugler EM, Cooke WH, et al. Hypotension begins at 110 mm Hg: redefining "hypotension" with data. *J Trauma.* 2007;63(2):291-7; discussion 7-9.
30. Oyetunji TA, Chang DC, Crompton JG, Greene WR, Efron DT, Haut ER, et al. Redefining hypotension in the elderly: normotension is not reassuring. *Arch Surg.* 2011;146(7):865-9.
31. Rogers A, Rogers F, Bradburn E, Krasne M, Lee J, Wu D, et al. Old and undertriaged: a lethal combination. *Am Surg.* 2012;78(6):711-5.
32. Chang DC, Bass RR, Cornwell EE, Mackenzie EJ. Undertriage of elderly trauma patients to state-designated trauma centers. *Arch Surg.* 2008;143(8):776-81; discussion 82.
33. Wisborg T. Nasjonal traumeplan - Traumesystem i Norge 2016. www.traumeplan.no: Nasjonal Kompetansetjeneste for Traumatologi - NKT- Traume; 2016.
34. Lov om pasient- og brukerrettigheter (pasient- og brukerrettighetsloven), LOV-1999-07-02-63 (1999).
35. Directorate NH. Beslutningsprosesser ved begrenning av livsforlengende behandling. Oslo: Norwegian Health Directorate; 2013.
36. Utter GH, Victorino GP, Wisner DH. Interhospital transfer occurs more slowly for elderly acute trauma patients. *J Emerg Med.* 2008;35(4):415-20.
37. Kirkman MA, Jenks T, Bouamra O, Edwards A, Yates D, Wilson MH. Increased mortality associated with cerebral contusions following trauma in the elderly: bad patients or bad management? *J Neurotrauma.* 2013;30(16):1385-90.
38. Alexander RH, Proctor HJ, American College of Surgeons. Committee on Trauma. Advanced trauma life support program for physicians : ATLS. 5th ed. Chicago, IL: American College of Surgeons; 1993.
39. Gowing R, Jain MK. Injury patterns and outcomes associated with elderly trauma victims in Kingston, Ontario. *Can J Surg.* 2007;50(6):437-44.
40. Demetriades D, Karaiskakis M, Velmahos G, Alo K, Newton E, Murray J, et al. Effect on outcome of early intensive management of geriatric trauma patients. *Br J Surg.* 2002;89(10):1319-

22.

41. van Aalst JA, Morris JA, Jr., Yates HK, Miller RS, Bass SM. Severely injured geriatric patients return to independent living: a study of factors influencing function and independence. *J Trauma*. 1991;31(8):1096-101; discussion 101-2.

42. Dehli T, Gaarder T, Christensen BJ, Vinjevoll OP, Wisborg T. Implementation of a trauma system in Norway: a national survey. *Acta Anaesthesiol Scand*. 2015;59(3):384-91.

43. Nasjonalt_traumeregister. Årsrapport 2017. Oslo: Oslo universitetssykehus; 2018.

44. Malterud K. Systematic text condensation: a strategy for qualitative analysis. *Scand J Public Health*. 2012;40(8):795-805.

