



Long-term follow-up of trauma patients before and after implementation of a physician-staffed helicopter: A prospective observational study



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ABSTRACT

Introduction: The first Danish Helicopter Emergency Medical Service (HEMS) was introduced May 1st 2010. The implementation was associated with lower 30-day mortality in severely injured patients. The aim of this study was to assess the long-term effects of HEMS on labour market affiliation and mortality of trauma patients.

Methods: Prospective, observational study with a maximum follow-up time of 4.5 years. Trauma patients from a 5-month period prior to the implementation of HEMS (pre-HEMS) were compared with patients from the first 12 months after implementation (post-HEMS). All analyses were adjusted for sex, age and Injury Severity Score.

Results: Of the total 1994 patients, 1790 were eligible for mortality analyses and 1172 ($n = 297$ pre-HEMS and $n = 875$ post-HEMS) for labour market analyses. Incidence rates of involuntary early retirement or death were 2.40 per 100 person-years pre-HEMS and 2.00 post-HEMS; corresponding to a hazard ratio (HR) of 0.72 (95% confidence interval (CI) 0.44–1.17; $p = 0.18$). The HR of involuntary early retirement was 0.79 (95% CI 0.44–1.43; $p = 0.43$). The prevalence of reduced work ability after three years were 21.4% vs. 17.7%, odds ratio (OR) = 0.78 (CI 0.53–1.14; $p = 0.20$). The proportions of patients on social transfer payments at least half the time during the three-year period were 30.5% vs. 23.4%, OR = 0.68 (CI 0.49–0.96; $p = 0.03$). HR for mortality was 0.92 (CI 0.62–1.35; $p = 0.66$).

Conclusions: The implementation of HEMS was associated with a significant reduction in time on social transfer payments. No significant differences were found in involuntary early retirement rate, long-term mortality, or work ability.

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Introduction

Trauma is a leading cause of death in young adults [1]. This has resulted in a demand for higher quality of emergency preparedness, and time-efficient transportation of severely injured patients has attracted growing public interest. Many countries have implemented helicopter-based systems to strengthen the emergency response, and the potential benefits have been studied several times [2,3]. Time gain and short-term mortality (up to 30 days) are the outcome variables most often applied in studies evaluating helicopter services against ground services [4–9].

In May 2010, the first physician-staffed Helicopter Emergency Medical Service (HEMS) was implemented in the eastern part of Denmark. The implementation was associated with improved short-term outcomes, such as reduced time to specialised care, fewer secondary transfers and lower 30-day mortality for severely injured trauma patients [10].

Mortality is a very crude outcome measure and it does not provide information on disabilities affecting work ability or dependency on social transfer payments. Initiatives to lower short-term mortality after trauma may be at the expense of a worse functional outcome. Hence, trauma may have negative impact on long-term employment or lead to involuntary early retirement, and persons who leave the workforce due to health problems may be more likely to become impoverished than those who retire in good health [11–13].

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The aim of the present study was to assess the long-term effects of the implementation of HEMS on labour market affiliation measured as involuntary early retirement, work ability, need for social transfer payments, and long-term mortality up to 4.5 years after the trauma.

The study was approved by The Danish Data Protection Agency (file number: 2013-41-1973 and 2013-231-0042) and by the National Board of Health (file number: 3-3013-352/1/HKR). Approval from the Ethics Committee as well as patient consent is not required for studies based on registries, according to Danish law.

Material and methods

Study design and setting

This was a prospective, observational study with long-term follow-up of the same cohort as in the initial study of the first Danish HEMS [10]. Eight trauma centres provided data, including one level 1 and seven level 3 or 4 eq. trauma centres. Before May 1st, 2010, the regional EMS consisted of a two-pronged ground unit system (1) An ambulance staffed with either basic life support providers or paramedics, and (2) A mobile emergency care unit staffed with consultants in anaesthesiology or anaesthetic nurses. In case of suspected severe trauma, the dispatch centre would dispatch both units simultaneously, with rendezvous at the site of the incident. Patients would either be brought to the nearest hospital or directly to the level 1 trauma centre at the discretion of a physician. On May 1st 2010, a physician-staffed HEMS was introduced to supplement the existing system. The HEMS operated during daytime only, covering a catchment area of 8400 km². HEMS was dispatched in case of suspected severe trauma, and when the expected driving distance from scene of incident to the level 1 trauma centre exceeded 30 min. HEMS was typically dispatched together with an ambulance unit, and occasionally together with both ambulance and MECU unit.

Selection of participants

All trauma patients treated in HEMS' catchment area in a 17-month period from December 1st 2009 to April 30th 2011, and who triggered trauma team activation in one of the eight trauma centres, were included. Follow-up period was until May 1st 2014. We excluded patients who upon arrival at the hospital were re-categorised as non-trauma patients, and patients who arrived by private transport or were brought in by the police.

Intervention

A 5-month period (December 1st 2009 to April 30th 2010) immediately before implementation of HEMS (pre-HEMS) was compared with the first 12 months (May 1st 2010 to April 30th 2011) after HEMS implementation (post-HEMS). Follow-up period was until May 1st 2014.

Data sources

Trauma records

Data were retrieved from trauma registration sheets as previously reported [10].

Danish civil registration system (DCRS)

The DCRS [14] is administered by the Danish government, which since 1968 has assigned a unique civil registration number (CPR number) to all persons who take up residence in Denmark

including foreign nationals. The registry includes vital statistics and demographic information, and is updated within days.

DREAM

Current employment status in Denmark was analysed using the Ministry of Employment's Danish Register for Evaluation of Marginalization (DREAM) database, which contains information on all social transfer payments such as sickness benefits, unemployment benefits, social assistance, and pensions (disability and old-age pension, public and private). The database includes all persons who have received social transfer payments from any Danish authority since 1991.

The DREAM database is administered by the Danish Agency for Labor Market and Recruitment (under the Ministry of Employment) and is updated weekly with a latency period of 3 months. A weekly code is assigned to each person, based on the kind of income (work salary or any type of social transfer payments). The codes are ranked internally and just a single day on any subsidy will trigger a weekly allowance code for not being employed full-time.

To meet the requirements for involuntary early retirement, citizens should be between age 18 and 64 years and have at least a 50% permanently reduced work capacity, preventing them from providing for themselves through profitable employment. Involuntary early retirement is independent of private insurance status and awarded for life. The application process may take from a few months up to two years.

Data extraction

From trauma records, we retrieved data on: specific injuries, injury severity score (ISS), mode of transportation, time intervals and demographics. From DREAM, we retrieved data on: labour market affiliation. From DCRS, we retrieved data on sex and dates of death or emigration. Data were linked through the CPR number.

Outcome measures

The primary endpoint was a combined outcome of time to involuntary early retirement (disability pension) or death of any cause after trauma.

Secondary endpoints were time to involuntary early retirement, time to death from any cause, prevalence of reduced work ability three years after trauma, and percentage of time on social transfer payments during the first three years after trauma.

Statistical analysis

Continuous variables are reported as medians and interquartile range (IQR) and compared between subgroups in the data using Mann-Whitney's *U* test. Categorical data are reported as numbers (%) and compared between subgroups in the data using a Chi-squared test. We consider *p*-values <0.05 as statistically significant. SAS 9.3 statistics (SAS Institute Inc., Cary NC 27513-2414, USA) was used for statistical analyses.

Survival analyses were conducted for the primary "combined outcome" and the two secondary outcomes of "involuntary early retirement" and "death from any cause. Incidence rates (IR) pre-HEMS and post-HEMS were calculated and illustrated in Kaplan-Meier plots. The relative difference in incidence between the two groups was analysed in Cox proportional hazards regression models, unadjusted as well as adjusted for sex, age, and ISS. Since no involuntary early retirement occurred in the 30 days directly following the trauma, statistics pertaining these first 30 days after trauma were not calculated for the secondary outcome "involuntary early retirement".

The secondary outcome of "prevalence of reduced work ability three years after trauma" was assessed in logistic regression models with adjustment for sex, age and ISS. Patients were

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