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ORIGINAL ARTICLE

Health-related quality of life in trauma patients at 12 months after injury: a prospective cohort study

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Abstract

Purpose Health-related quality of life (HRQOL) is increasingly recognized as a benchmark in trauma outcome research, with few studies having evaluated the HRQOL in trauma patients. The aim of our study was to assess the change in trauma patients' HRQOL at 12 months post-injury and to describe their living situation and return to work status.

Methods A prospective cohort study was performed at a Japanese tertiary care hospital from September 2013 to September 2015. The short-form (SF-36) health survey was used at discharge, and 6 and 12 months post-injury. We obtained information regarding living situation at 12 months post-injury.

Results Complete data were collected from 129 patients. The median age and injury severity score were 66 years 17, respectively. The physical and role-social component scores improved significantly between hospital discharge and 6 months post-injury. However, the mental component score decreased significantly during this period. There was no significant increase in any of the 3 SF-36 component scores between 6 and 12 months post-injury. At 12 months post-injury, 106 (82%) patients were independent and 15 (12%) patients were dependent on home care services. The return to work rate was 65% (47/72).

Conclusions Our study suggests that the quality-of-life of Japanese trauma patients generally improved over time, but remained lower than the Japanese national average. Most trauma patients return to home and work within 12 months post-injury.

Keywords Health-related quality-of-life · Trauma patients · Observational study · Outcomes

Introduction

Trauma patients experience reduced quality of life, functional ability, and psychological status. They face a variety of challenges regarding physical function, emotional well-being, economic issues, and role-social problems [1]. Health-related quality-of-life (HRQOL) is increasingly being recognized as a benchmark in trauma outcomes research [2–4]. In light of the need for HRQOL assessment in trauma patients, some retrospective and few prospective studies have evaluated HRQOL or living situation after trauma [5, 6].

The aim of our study was to prospectively assess HRQOL improvement of trauma patients at 12 months after injury, and to describe their living situation and return to work status. This study was approved by the Ethical Committee at Kurashiki Central Hospital, Japan.

Materials and methods

We conducted a prospective cohort study at Kurashiki Central Hospital from September 2013 to September 2015. Kurashiki Central Hospital is a tertiary care hospital in Kurashiki, the second-largest community in the Okayama Prefecture, which is located in midwestern Japan. The population of the city has been stable for several years (474,415 in 2009) and is considered to be representative of a medium-sized Japanese city [7–9]. The study population included all eligible consecutive trauma patients that were admitted to

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our intensive care unit and trauma ward. We excluded the following patients: (1) those under the age of 18 years; (2) those with coexisting cognitive impairment; (3) those who died in our hospital; (4) those with cancer at admission; (5) those who did not consent to participation in this study. We excluded patients who were cancer-bearing at admission because cancer greatly influences patients' HRQOL [10–13]. We collected the following patient information: age, sex, mechanism of injury, injury severity score (ISS), location of injury, length of hospital stay, the period from injury to returning home, and the period from injury to return to work. In Japan, most trauma patients are transferred from trauma centers to rehabilitation facilities once they are stabilized. The period from the injury and to returning home could be longer than the length of hospital stay in this study. We used the short-form 36 (SF-36) health survey to assess patient HRQOL. The SF-36 is a widely used instrument to measure HRQOL and is a self-administered questionnaire that consists of 36 items in 8 domains: physical functioning, role functioning, bodily pain, general health, vitality, social functioning, role-emotional, and mental health. These 8 domains are summarized by 3 component scores: physical component score (PCS), mental component score (MCS), and role-social component score (RCS) [14]. Each of the 3 component scores is transformed into a score on a 0–100 scale, under the assumption that each question carries equal weight.

Scores of 0 and 100 are equivalent to maximum disability and no disability, respectively. The age/sex adjusted scores are comparable to a mean of 50 and a SD of 10 in the general Japanese population. In our study, we used the 3-component summary scores to analyze HRQOL improvement in trauma patients over a 12-month period and adjusted the 8 domain scores by age and sex when comparing the 12-month HRQOL scores with the Japanese national averages. The 3-component summary score is more easily interpreted for assessing trends and the 8-domain scores show more detailed HRQOL for a particular category.

We obtained the SF-36 scores by direct interviews based on a standardized protocol at discharge from our hospital. The change in SF-36 scores was obtained by sending questionnaires to participants at 6 and 12 months after injury. We collected the first SF-36 data on each patient by direct interview because this assistance helped our study participants, especially the elderly patients, to provide their answer correctly. The users' manual for SF-36 allows the investigators to interview their study participants, which is also validated in a study [15]. We followed their changes for 1 year and obtained the information about their living situation and whether they could return to work by 12 months after injury. We classified their living situation as follows; living independently, being dependent on home care services, and being accommodated in institutions or hospitals. The primary outcome was the change in the 3-component summary scores of the SF-36. We described patients' living situation and the frequency/proportion of return to work at 12 months after injury.

We presented data as values with percentages (%) for categorical variables and the median with interquartile ranges (IQR) for continuous variables. We used the paired Wilcoxon signed-rank test for change in scores over time. We compared the characteristics of patients included in this study and those who did not respond to the questionnaires over 12 months (non-responding patients). We used the Mann–Whitney *U* test and the Fisher's exact test for continuous and dichotomous variables, respectively, between those who responded to the questionnaire and non-responding patients. A statistical significance was considered to be $p < 0.05$. Statistical data were analyzed using SPSS statistics software version 20 (IBM Corp., Armonk, NY). The Institutional Review Board of the Kurashiki Central Hospital approved this study.

Results

During the study period, 388 trauma patients were admitted to our department. Of these, 55 patients were under the age of 18 years, 65 could not answer the questionnaire due to cognitive impairment, 15 died at our hospital, 14 had cancer upon admission, and 55 did not give consent. The remaining 187 patients were included in the analysis. Complete data collection was achieved in 129 out of 187 patients (response rate, 69%) (Fig. 1). There was no significantly difference in age, sex, ISS, mechanism of injury or length of hospital stay between the included patients and the non-responding patients. In included patients, there were more frequent severe injuries (AIS ≥ 3) in the part of abdomen, pelvis, spine and extremity (Table 1).

The included 129 patients had a median age of 66 years and 82 (64%) were male. The median ISS was 17, and length of hospital stay was 15 days. The median period from injury to returning home was 41 days. Most of the injuries were blunt-force trauma (128/129: 99%) resulting from road traffic injury ($n = 66$, 51%), falls ($n = 29$, 22%), ground-level falls ($n = 12$, 9%), and others ($n = 22$, 17%).

Health-related quality of life scores

PCS and RCS improved significantly between hospital discharge and 6 months post-injury. However, MCS decreased significantly during this period. There was no significant increase in any of the 3 component scores in SF-36 between 6 and 12 months post-injury. The median of all domain scores at 12 months were lower than 50, which is

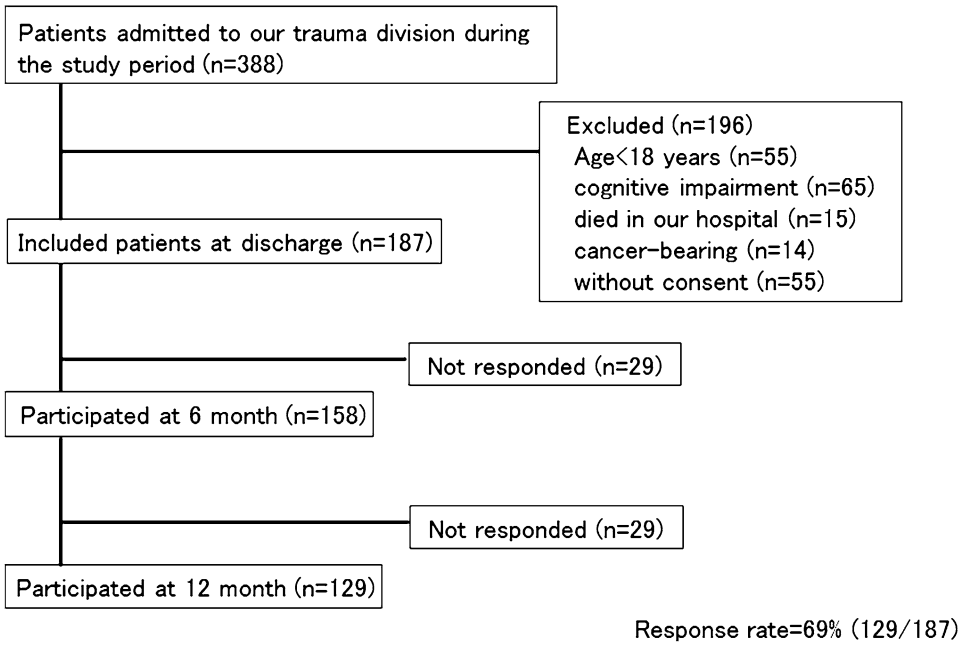

Fig. 1 Patient selection

Table 1 Characteristics of patients included in our study and those who did not respond to the survey

	Included patients ($n=129$)	Excluded, non-responding patients ($n=58$)	P value
Age	66 (54, 75)	68 (49, 80)	0.45
Sex (male/female)	82/47	37/21	1.00
Injury Severity Index	17 (13, 24)	17 (10, 22)	0.35
Location of injury (AIS ≧ 3)			
Head	47	26	0.33
Chest	24	21	0.015
Abdomen pelvis	37	6	0.005
Spine	41	10	0.050
Extremity	76	9	< 0.001
Other location	64	2	< 0.001
Mechanism of injury			0.061
Road traffic injury	66	26	
Ground-level fall	12	13	
Fall	29	14	
Others	22	5	
Length of hospital stay (day)	15 (6, 35)	18 (7, 35)	0.62

Continuous data are presented in medians with the first and third interquartile range in the brackets

the Japanese national average after adjusting for age and sex (Tables 2, 3).

Living situation

Before injury, 125 (96%) patients lived independently. At 12 months post-injury, 106 (82%) patients lived independently, 15 (12%) patients were dependent on home care services, and 8 (6%) patients were still institutionalized (Fig. 2). Moreover, 106 of 125 (85%) patients who had lived independently prior to trauma could do so again at 12 months post-injury, and 121 of 125 (97%) patients would return home.

Return to work

At the time of injury, 72 patients had been employed. At 12 months post-injury, 47 of 72 (65%) patients returned to work (Fig. 3).

Table 2 The trend of three-component summary scores over 12 months

	At discharge	6 months after injury	12 months after injury	*P* value*	*P* value**
Physical component score	21 (10, 35)	43 (33, 51)	44 (32, 53)	< 0.001	0.74
Mental component score	56 (48, 66)	52 (44, 61)	53 (46, 59)	0.001	0.78
Role-social component score	21 (10, 38)	39 (23, 52)	45 (29, 53)	< 0.001	0.52

Continuous data are presented in medians with the first and third interquartile range in the brackets

*Comparison of at discharge and 6 months after injury

**Comparison of 6 months after injury and 12 months after injury

Table 3 Adjusted 8-domain scores at 12 months after injury

Subdomain of SF-36	
Physical functioning	48 (38, 35)
Role physical	44 (30, 54)
Bodily pain	46 (38, 54)
General health	47 (42, 56)
Vitality	46 (39, 52)
Social functioning	46 (33, 56)
Role-emotional	49 (34, 55)
Mental health	47 (39, 55)

Data are presented in median with the first and third interquartile range in the brackets

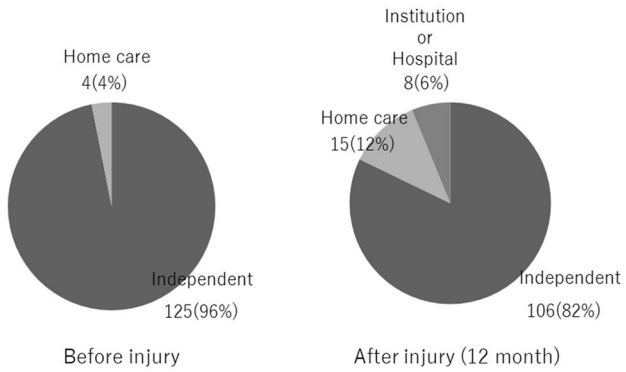

Fig. 2 Living situation at 12 months after injury

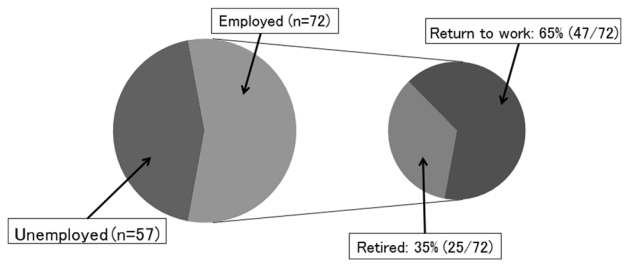

Fig. 3 Return to work at 12 months after injury

Discussion

This study examined HRQOL trends for trauma patients over a 12-month period. While outcome measures for trauma care previously focused on mortality or morbidity, more attention has been payed to HRQOL, functional ability, and mental status, with few prospective studies having clarified HRQOL trends after trauma. Our study suggests that many aspects of trauma patients' HRQOL improve 6 months post-surgery, but further improvement is not observed after an additional 6 months post-injury. Approximately 85 and 65% of our patients were able to live independently and could return to work again, respectively.

Japan is an aging society, with those ≥ 65 years old accounting for 26% of the total Japanese population and 20% continuing to work [16]. The median age of our cohort was 68 years, with 57% over 65 years old. It takes a longer time and costs more for geriatric trauma patients to recover from the injured status. Some studies have suggested that unfavorable outcomes in geriatric trauma patients were associated with higher Charlson Comorbidity Index, a marker of comorbidities, or higher Trauma-Specific Frailty Index in geriatric trauma patients [17, 18] which all indicate that the baseline function or disease status of geriatric patients may affect their final outcome. In addition, Inaba et al. have reported that trauma negatively impacts the HRQOL of geriatric populations [19]. Since many developed countries are gradually aging, the information from our study will be useful.

PCS and RCS improved significantly between hospital discharge and 6 months post-injury. However, MCS decreased significantly during this period. Aitken et al. reported that physical functioning significantly decreased 1 month after hospital discharge and improved markedly by 6 months, with continued improvement over 24 months. However, mental health did not decrease drastically at 1 month post-discharge and only improved slightly over 24 months [20]. These trends in the physical functioning and role-physical domains are consistent with our study. The population age examined by Aitken et al. was much younger than ours (median, 37 years old). Interestingly, the changes in quality-of-life between older and younger trauma patients

are similar. In our study, MCS decreased significantly between hospital discharge and 6 months post-injury, but we could not identify the cause. We speculate that patients did not realize their trauma-based disabilities at discharge due to supporting care, but faced disabilities after discharge without this support.

Wanner et al. reported that trauma patients experienced a variety of issues with emotional well-being, functional engagement, resilience, peritraumatic experience, and physical well-being after returning to home (1). In our study, there was no significant increase in any SF-36 component summary between 6 and 12 months post-injury, with all 12-month domain scores being lower than 50, which is normal. Our study is consistent with Wanner et al.'s and suggests the need for support of physical, mental, and social well-being.

Kucan et al. reported that systematic care management (SCM) was valuable for an optimal long-term recovery from burn injury and provided a highly organized system of management throughout the spectrum of care, broader access to providers, and appropriate allocation of resources [21]. In Japan, a follow-up system for trauma patients, like SCM, is warranted.

Gabbe et al. reported return to work rates of Australian trauma patients with ISS ≥ 12 as 58%, 66%, and 70% at 6, 12, and 24 months, respectively. The negative predictive factors were female sex, older age, those with pre-existing conditions, patients with greater socioeconomics disadvantage, spinal cord injury, polytrauma, and specific occupations [22]. In our study, 47 of 72 employed patients (65%) returned to work within 12 months post-injury. However, we did not collect data regarding pre-existing conditions, socioeconomics, or occupation. The post-injury return to work rate is an important outcome that is dependent on a country's social structure. Further research related to the return to work rate in Japan is needed. Jackson et al. reported that certain cognitively impaired patients were less likely to return to work than non-impaired patients between 12 and 24 months post-injury (17). In our study, 65 cognitive impaired patients at discharge were excluded. Although we did not measure the return to work rate of these patients, inclusion of such patients would cause a further decrease.

Living situation is an important outcome as a proxy marker for patient independence. Inaba et al. reported for elderly trauma patients aged ≥ 65 years, 63% were living dependently; 31% were dependent on others, including homecare, spouse, or family in their home; and 6% were institutionalized [19]. Zietlow et al. reported that of trauma patients ≥ 65 years old and having an ISS > 10, 75% lived at home with an independent functional status, at 12 months post-injury [23]. van Aalst et al. showed in a cohort with an average age of 73 years and ISS score of 23, at a follow-up of 2.8 years, that 67% returned home with independent living [24]. In our study, 82% of patients lived independently, 12% were dependent on home care services, and 6% were institutionalized at 12 months post-injury. The period between injury and returning home was 51 days, with 97% of our patients returning home by 12 months post-injury. Recently, the Japanese government promoted the integrated community care system, which aims to provide long-term care, including rehabilitation and patient home care, as long as possible due to an increase in long-term care expenses from the aging society placing a financial burden on the working generation [25]. Given that trauma is rare in Japan, the rehabilitation and support of trauma patients after returning home has not attracted attention. Therefore, it is desirable to make the best use of financial resources so that trauma patients will be able to function in society as they did before injury.

Our study had several strengths. First, we had an adequate response rate of 69%. An acceptable response rate in social surveys has not been established, but Asch et al. reported the mean response rate among mail survey published in medical journals was about 60%. The response rate in our study is higher than that in average medical questionnaire mail survey [26]. Second, there was no significant difference in the characteristics between the 129 analyzed patients and the 58 non-responders, suggesting a lack of selection bias. Third, to our knowledge, our study is the first to examine both HRQOL and the return to work rate of Japanese trauma patients.

Our study had some limitations. First, the sample size of our cohort was small. However, trauma due to any etiologies is less common in Japan, compared with Western countries. Kurashiki City is a representative medium-sized city, and our hospital covers almost all patients who experience trauma in the area (355 km^2) [7–9]. Therefore, our results should represent that of Japanese trauma patients. Second, HRQOL scores before injury were not measured in our study. Feemster et al. evaluated the change of HRQOL before and after hospitalization in a multicenter randomized trial and reported that pre-hospital HRQOL is a significant determinant of HRQOL after hospitalization [27]. In our study, 96% of the patients lived independently and did not require any home care services before injury. It is unlikely that HRQOL scores before injury were much lower than national averages, and as shown above, the HRQOL of trauma patients were lower during the study period. Third, 65 patients did not answer questionnaires due to cognitive impairment from traumatic brain injury being excluded. Some studies have assessed the long-term outcomes of patients with traumatic brain injury using the neurobehavioral rating scale-revised, functional independence measure, or Glasgow outcome scale [28]. Our study measured HRQOL of trauma patients with only SF-36 scores and could not assess patients with altered mental status. Third, as related

to the point discussed above, delirium can be reversible in some patients. Studies that assess long-term outcomes of patients who become delirious after trauma are also warranted. Fourth, our participants were relatively old, which may limit the generalizability of our study finding. Further, the Japanese healthcare system may be unique in contrast to those of other nations. Despite these limitations, however, Japan is the most aging nation in the world and our finding should be informing to other younger nations.

Conclusions

Our study suggests that Japanese trauma patient quality-of-life will improve within 6 months post-injury. However, there was no significant improvement in quality-of-life between 6 and 12 months post-injury, with HRQOL scores being lower than Japanese national averages. Most trauma patients return to home and work within 12 months post-injury. Support for both social and mental status of trauma patients is needed after discharge.

Compliance with ethical standards

Conflict of interest Nobuichiro Tamura, Akira Kuriyama, Toshie Kaihara declare that they have no conflict of interest.

Ethical approval The Institutional Review Board of the Kurashiki Central Hospital approved this study.

Informed consent We obtained informed consent from all included patients.

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