Predictors for Early Discharge Planning of Hospitalized Acute Geriatric Patients, a Retrospective Study

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Abstract

Purpose: When treated for an acute disorder, older adults are vulnerable for functional losses and the need of care after discharge. In a specialised geriatric ward, patients get a comprehensive treatment complementary to medical care in order to maintain and improve mobility and Activities of Daily Living (ADL) to facilitate the return to domesticity. The aim of this paper is to identify the relevant assessments at admission to predict the status at discharge for early discharge planning.

Method: In a retrospective cohort study with 351 patients, we analysed the impact of acute geriatric early rehabilitation on the functional outcome after treatment. As a sufficient improvement of ADLs and mobility we defined as a suitable endpoint at least 60 Barthel Points (ADL) and the ability for "Timed-Up-and-Go-Test" (TUG) when discharged from hospital care. To identify relevant predictors in the set of the screening assessments at admission we used linear and logistic regressions as well as odds-ratios.

Results: Statistical analysis shows that all patients benefit significantly from early rehabilitation in ADLs and the physical function. Barthel-Score, walking distance, cognition and handgrip are the strongest predictors for the outcome. Clinical condition, the medical treatment before admission, length of hospitalization, age or gender have no predictive quality.

Keywords: Acute geriatric care; Barthel score; Comprehensive treatment; Discharge planning; Geriatric assessments; Predictor analysis; Timed up and go test

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Introduction

In western countries up to 50% [1] of the admitted patients are 65 years or older and most of them live at home (74% in Germany and 67.5% in OECD25 [2]). However, older patients in hospitals suffer severe risks of functional decline. Early rehabilitation of the elderly along with the clinical treatment in specialized acute geriatric wards, labeled often as Acute Care for the Elderly units (ACE), minimizes these risks. Such a treatment is important to facilitate a return to their previous social and domestic live [1,3,4]. Despite successful medical treatment, many patients need support or even institutional care after discharge. Discharge planning is an important task and should start as early as possible. Hence predictors for the expected level of independence at discharge would be helpful.

To explore the potential of a patient we need a useful and efficient outcome measure. There is a wide variety of outcome measures reported in the literature [5]. Independent or moderately assisted living requires a certain capability in ADLs plus a basic mobility. Outcome measures in a meta-analysis for acute geriatric early rehabilitation use ADL-capacity (BS) as a typical indicator, substantiated in many cases by mobility criteria [5-9]. As a sufficient improvement of ADLs and mobility, we define as a suitable endpoint at least 60 Barthel-Points, which is the approved level of independence for acceptance in a further rehabilitation unit and the ability for an untimed TUG for functional performance.

Methods

Procedures and participants

Participants in this retrospective cross sectional study were 580 randomly chosen patients of the acute geriatric ward of a medium sized hospital in a rural area in Germany from 2009-2019. Reaching the endpoint successfully is meaningful only for patients whose BA

Abbreviations

ADL: Activities of Daily Living
BS: Barthel-Score
BA: Barthel-Score at Admission
BD: Barthel Score at Discharge
CDT: Shulman’s Clock-Drawing-Test
GDS: Geriatric Depression Scale
HG: Handgrip averaged over both hands in kPa
M: Mean
MMSE: Mini-Mental State Examination
SD: Standard Deviation
TUG: Timed-up and Go-Test (in seconds)
TUG A: Timed-up and Go-Test at Admission
TUG D: Timed-up and Go-Test at Discharge
WD: Walking Distance in meter
is less than 60 to avoid biasing. This applies for 351 of the basic cohort. Patients are typically aged >70 years, have multiple chronic illnesses and an acute disorder. They are transferred from the surgical or internal ward of the hospital or other hospitals nearby. The disorders treated were internal (apoplexy, cardio-vascular disorders, diabetes, pneumonia, infections) or surgical (fractures of femoral neck, pelvis, vertebral bodies and humerus, treated surgically or conservatively) or convalescents after abdominal or cardiac surgery.

During their stay (typically 14 days) patients get, complementary to acute medical care, a comprehensive training in order to maintain and improve mobility and activities of daily living. The rehabilitative training comprises intense activating daily care, physiotherapy, occupational therapy, physical exercise, cognitive training and if needed speech therapy and psychological consulting. Typically, ten multidisciplinary therapeutic training sessions are scheduled per week. The training meets the specific individual deficits of a patient. Nurses, therapists and doctors in the geriatric ward have a special geriatric qualification and meet regularly to discuss the development of the patients.

We use the following assessments, accredited by the geriatric association, at admission and discharge.

**Tests applied at admission:** Barthel-Score (BS), Timed-up and Go-Test (TUG), Walking Distance (WD) and Handgrip Strength (HG), Shulman’s Clock-Drawing-Test (CDT) and Mini-Mental State Examination (MMSE) and the Geriatric Depression Scale (GDS).

**Tests before discharge:** for physical function (TUG, HG, WD) and BS.

The Barthel-Score (BS) is a marker for the performance in ADL. A higher score is associated with a greater likelihood of being able to live with a certain degree of independence. A score 60-75 indicates a medium sized impairment. Below 60 there is growing dysfunctionality with falling Barthel-Scores. There is none or only a slight impairment for scores from 80 to 95. Handgrip strength correlates positively with overall physical performance and has a predictive validity for decline in cognition and mobility [10-12]. Handgrip is measured in kPa using the Vigorimeter (KLS Martin), which is as reliable as the JAMAR Dynamometer [13]. In the present study, we consider the averaged pressure of both hands.

TUG-testing results indicate fall risks and measure the impairment of mobility by taking the time in seconds required to stand up from a chair, followed by walking 3 meters, turn around walk back and sit down again. The TUG-performance is measured in seconds and is a quantitative indicator for physical functioning, frailty and falling risk [14,15]. A TUG time more than 12 seconds is predictive for future falls [16-18]. A drawback of the timed TUG-test is that many patients are not able to stand up and therefore are incapable to perform the timed test. Hence, a certain improvement in seconds at discharge is an outcome measure with a large floor effect. Dichotomous Tests (TUG timed test) are not able to stand up and therefore are incapable to perform the timed test. Both outcome targets combined form a meaningful endpoint.

**Statistical methods**

We use SPSS 27 to perform the statistical analysis [25] of the assessment data with a significance-level \( p < 0.05 \) used throughout. The magnitude of a certain effect is measured using the standardized effect-size parameter \( f \): 0.40 strong, 0.25 medium, 0.10 small [26].

The chi-squared test is used to examine odds-ratios, which quantify the impact of dichotomous measures (e.g., gender) on the outcome. We use linear and logistic regressions to examine the impact of the screening parameters taken at admission on the outcome at discharge. Logistic regression analysis comprises correlation of predictors with endpoints. Logistic regression defines a model for the probability to reach a certain condition, here to meet the endpoint, using \( P = 0.5 \) as the classification cutoff.

**Results**

**ADLs and other metric scores at admission and discharge**

Table 1 shows all metric scores taken at admission. The scores at discharge, only taken for BS, TUG, HG and WD, have significantly improved. Figure 1 shows the improvement of ADLs.

In table 2 we list the improvements of the 164 patients reaching the endpoint in comparison to those (187) who failed. Patients reaching the endpoint had a significant higher BD than those who failed. Patients who were able to do the TUG test at discharge had a higher increase of BS than those who didn’t. Those who didn’t reach the endpoint but were able to do the TUG failed because of an insufficient improvement of BS (-7.5 and 17.5) but the difference in TUG time compared to the successful patients was not significant.
We analysed the predictors for BD, TUG D and the endpoint with linear and logistic regression. The results in table 3 show the important and significant predictors (Figure 2). Their strength is determined using their corresponding effect sizes.

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Age as a confounder?

To rule out age as a confounder for the dominant predictors, we analyze bivariate linear regressions for BA, WD, MMSE and HG with age as the input variable. Age is a significant predictor only for handgrip but with a small effect size ($p=0.027$, $f^2=0.120$).

Odds-ratios for nominal predictors

Some of the admission scores are binary: gender, main diagnosis, admission from the internal or surgical ward with conservative treatment or surgery. To quantify their influence, we investigated Odds-Ratios (Table 4 and Figure 3). Moreover, for rounding up the above findings, we transform metric predictors into binary ones by using the median values taken from descriptive statistics table 1. For CDT, GDS and MMSE the threshold is set to the cut-off between impairment and no impairment. Figure 3 visualizes the results.

**Discussion**

We investigated the impact of early in-patient rehabilitation along with medical treatment in a specialized acute geriatric ward. The aim of this paper was to study the improvements of the patient’s condition from admission to discharge using standardized screening parameters [5] combine ADLs with mobility.
We use in this study for ADLs at discharge (BD ≥60) and for mobility a successful Timed-Up-and-Go-Test (TUG D = possible). A combination of both form the endpoint, which corresponds to a reasonable level of physical functioning and independence after treatment.

Descriptive statistics showed that the Barthel-score was significantly higher at discharge than at admission, with a strong effect size. Handgrip and Walking Distance also improve significantly at discharge. Patients starting the treatment with a BA between 20 and 55 points have an improvement of more than 20 points, which corresponds to a substantial reduction of the assistance needed after discharge. If 20 points is the average improvement, we see that 40 Barthel-points at admission indicate that a patient may leave the hospital with a mild ADL-impairment (BD ≥60). Patients able to do the TUG at admission have an improvement of 9sec to 20s. Patients, not able to do the TUG ad admission, were able to reach the endpoint with a TUG time of 25 seconds. Their ADL improvement was significantly higher (ABS 28.3) than those who failed (ABS 17.5).

This confirms the expected relation [5,7] between ADLs and TUG, because both measures reflect the mobility-status of a patient. BS is widely accepted [1,7] as the fundamental measure for functionality in daily living. However, Barthel-testing is less strict in quantifying the transfer capability and walking. In order to find predictors for BS-improvement we use linear regression models and classify the relevance of the significant predictors by effect sizes. As expected, the Barthel score at Admission (BA) has the strongest impact. This is in accordance with the literature [7,8]. MMSE also has a strong and HG a medium effect size. WD follows with a small effect size. Age, weight and duration of treatment are non-significant for BD. These findings are in accordance with a meta-analysis [9], which showed limited differences in the outcome.

Odds-Ratios for reaching the endpoint support the ranking of metric predictors by effect sizes. Significant Odds were found for BA ≥40, WD ≥15m, MMSE ≥24 and HG ≥25 kPa. In case of the surgical patients only conservative treatment is significantly favorable as compared to an operation, and patients admitted from an internal ward have higher Odds than those from a surgical ward. Again BA and WD are most important, followed by MMSE and HG. Note, that age and gender yield non-significant Odds.

Age is expected to be a marker for functional decline and hence maybe confounding. However, bivariate linear regression for BA, WD, MMSE with age as predictor result in non-significant models. HG is the only predictor that exhibits a significant correlation with age as reported already in [28] and declines by 0.29 kPa/year of age, which is of no clinical relevance. Age is no relevant confounder for the dominant predictors. Even the oldest benefit from the comprehensive treatment and improve their ADLs and mobility significantly as already noted in [9].

**Conclusion**

As a basic rule, which could be useful in clinical practice, we find that a substantial BA-score of around 40 is the best starting point for the comprehensive treatment. This should be backed up by walking distance of more than 15m. Patients with these competences at admission are very likely to reach a basic level of independence at discharge. We emphasize that some parameters of the patient’s status at admission, which seem to be important at first glance, lack...
any predictive quality. In particular, these are clinical condition, the
medical treatment, length of hospitalization, weight, age or gender.
They are non-predictive for increased mobility and independence.
Even if the combined endpoint is not achieved, all geriatric patients
benefit from acute rehabilitative care of the elderly.

Availability of Data and Materials

Data are available on request to the author B. Hoppe (bernhard.
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Ethics Approval and Consent to Participate

This study was performed in accordance with the Declaration of
Helsinki. Written informed consent to the use of their anonymized
health data obtained during their stay in the hospital was provided
from each participant during the standard procedures at admission.
This has been approved by the ethics committee of the Krankenhaus
Korbach, Korbach, Hesse, Germany. The study was retrospectively
registered on 2nd July 2019 by the ethic commission of the hospital
and filed under registration number (MG1/569/770/2019).

Competing Interests

The authors confirm that there are no competing interests.

Author’s Contribution

AH designed the study and collected the patients’ data. BH
analyzed and interpreted the data using statistical methods. AH
analyzed the clinical impact of the analysis. Both authors contributed
on equal shares in writing the manuscript and have read and approved
the final manuscript.

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