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Predictors of Functional Improvement Among Patients with Hip Fracture at a Rehabilitation Ward

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Abstract: To determine possible predictors of FIM scores in patients with hip fracture at discharge a prospective cohort study of 117 patients with either DHS or hip arthroplasty admitted to a rehabilitation service was done. They were classified into four subgroups of underweight (BMI < 18.5), normal (18.5 < BMI < 24.9), overweight (25 < BMI < 29.9) and obese (30 < BMI < 35). Functional evaluations using FIM score as well as sitting, standing, walking days and length of stay for each patient were assessed by a highly skilled therapist at rehabilitation admission; discharge and a post discharge follow up. Recovery was significant in terms of motor subscale. No significant correlation was evident between hospitalization and discharge time with respect to cognitive subscale. The study showed only the age and FIM score at hospitalization to be the independent predictors of total FIM score at discharge. Elevated BMI has not adverse effect on FIM gains in patients with hip fractures. Simple surgery methods such as DHS revealed earlier recovery time than complicated procedures.

Key words: Rehabilitation, body mass index, hip fracture, functional improvement measure

INTRODUCTION

Hip fracture is one of the most prevalent health issues among elderly people. It causes a variety of physiological, anatomical and psychological impairments decreasing the activity of the elderly and puts a great sum of financial burden either on patients or societies.

Hip fracture is a break near the top of femur somewhere like its head, neck, trochanter or intertrochanter. In most instances, hospitalization and surgeries like Dynamic Hip Screw (DHS) or hip arthroplasty are required.

Decreasing the rehabilitation period of the affected patients is an important issue to be relieved from its burden. The effect of several factors including age, sex and weight has been demonstrated on the outcome of rehabilitation among patients with stroke (Kalichman *et al.*, 2007), acute burns (Farrell *et al.*, 2008), knee arthroplasty (Vincent *et al.*, 2007a) and total hip arthroplasty (Vincent *et al.*, 2007a).

Based upon Vincent *et al.* (2007b) studies rehabilitation teams can expect comparable gains between obese and non-obese patients following total knee arthroplasty, but at a greater expense.

In another study by Vincent *et al.* (2007b) it was revealed that elevated BMI does not prevent FIM gains in THA patients during inpatient rehabilitation. However, BMI is related with FIM efficiency, LOS and hospital charges in a curvilinear fashion. Severely obese patients can achieve physical improvements but at a lower efficiency and greater cost.

Farrell *et al.*, studies show that patients aged 54 years or higher with less than 22.50% total body surface area (TBSA) burn and a higher BMI (>25.15) demonstrated lower FIM locomotion scores than corresponding patients with a lower BMI (<25.15) (Farrell *et al.*, 2008).

Tyrkalska *et al.* (2004) found that the quality of rehabilitation in patients with degenerative changes of the knee joint is better among patients having BMI in the normal range or only somewhat above.

In another study by Kalichman *et al.* (2007) it was shown that sex has no effect on rehabilitation outcome, whereas rehabilitation is significantly less effective in overweight and particularly, in obese patients (evaluated by BMI). The study also found a statistically significant negative association between the individual's BMI and relative improvement of the FIM score, representing the functional status of the stroke patients (Kalichman *et al.*, 2007).

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Contrary to aforementioned findings, there is a study showing that obese patients have higher gains in FIM scores as compared with patients with BMI in the normal range (Jain *et al.*, 2008).

According to existing conflicts in research results, lack of a comprehensive research in our society in this regard and accumulation of referred patients to our physical medicine and rehabilitation wards with hip fractures who had undergone the operation of total hip arthroplasty, we decided to conduct a cohort study to assess Functional Improvement Measurement (FIM) of patients with hip fractures in our rehabilitation ward and to determine possible predictors of their FIM scores at discharge time. A specific focus was put on investigating the association between Body Mass Index (BMI) of the patients and their rehabilitation quality determined by FIM.

MATERIALS AND METHODS

In a prospective cohort study, we evaluated 117 white patients hospitalized at the Physical Medicine and Rehabilitation ward of Shohada Hospital, Tabriz, Iran from September 2007 to November 2009. These patients had undergone either DHS or hip arthroplasty surgeries.

Orthopedic patients who had undergone the procedure of arthroplasty or DHS were eligible for the study. Patients with recent stroke; cognitive and psychological problems; amputated patients and those operated for total non-cemented hip arthroplasty were excluded from the study.

Functional evaluation was assessed by a highly experienced therapist in Functional Independence Measure (FIM) evaluation at rehabilitation admission; discharge and a post discharge follow up. The follow up evaluation was done at least two months after discharge from the rehabilitation ward. The FIM score assesses basic activities of daily living. Its score ranges from 18 (total dependence) to 126 (total independence).

In the study, check lists composed of demographic data of the patients, their probable diseases including diabetes mellitus (Powers, 2005), hypertension (Fisher and Williams, 2005), fracture region and fixation methods were filled out.

Then, after determining each patient's FIM score, his or her sitting day, standing day, walking day and finally length of stay at our rehabilitation ward were measured.

Having measured patients' weight and height and calculating their BMIs by the same therapist, they were classified into four subgroups with respect to their BMIs, i.e., underweight (BMI<18.5), normal (18.5<BMI<24.9), overweight (25<BMI<29.9) and obese (30<BMI<35).

For sample size estimation based on correlation between BMI and FIM score, we used Ronald Fisher's classic z-transformation to normalize the distribution of Karl Pearson's correlation coefficient.

Data were entered into the computer and analyzed by STATA version 8 statistical software package. Both descriptive and analytical statistics were used. Multivariate linear regression was the main method of analysis to model predictors of FIM score as well as length of stay in rehabilitation ward. Residual distribution and residual versus fitted plots were used to check for regression assumptions. Final statistical significance level of tests was set at 0.05.

Verbal informed consent was obtained from all patients participating in this study. Regional committee of ethics located in Tabriz University of medical sciences approved the study protocol.

RESULTS

From 117 patients entered into our study, males constituted 48.7% of the participants (54 males and 60 females). Mean age of participants was 69.8±13.4 years (Mean±SD). Mean BMI among patients entered into the study was 23.7±4.

Femoral head was the fracture region in 13 patients, femoral neck in 64 patients and intertrochanteric region in 37 patients. Only in three patients the fracture had occurred at the Trochanter. DHS was the fixation method in 65% of patients and the remainders were operated using Hip Replacement Arthroplasty. The 25.6% of cases were hypertensive and 12% of them were diabetic. Only 9.4% of our participants had used sedative agents.

Participants started sitting in 2.8 days (95% CI: 2.6-2.3). Mean standing and walking days were 4.1 and 4.2 days after operation, respectively. The mean length of the walking measured for 114 patients was 3.6±2.3 m. Mean Length of Stay (LOS) at the physical medicine and rehabilitation ward was 4.7±1.3 days. LOS could be predicted by receiving sedation, fracture region and BMI using linear regression analysis, but the model didn't sufficiently explain variation in length of stay.

Based on our categorization with respect to BMI, nine patients were recognized as underweight, 72 as normal, 27 as overweight and nine as obese.

Total FIM increased on average from a baseline score of 61.4±9.4 up to 69.5±11.5 at discharge time. It reached to 95.5±5.1 when patients were followed up at least two months later. Changes of sphincter control and transfers were from 7.4±2.3 to 7.8±2.3 and 3.6±1.3 to 5±1.6 during the same period, respectively.

Table 1: Correlation between total FIM score and its subgroup scores at hospitalization and discharge times

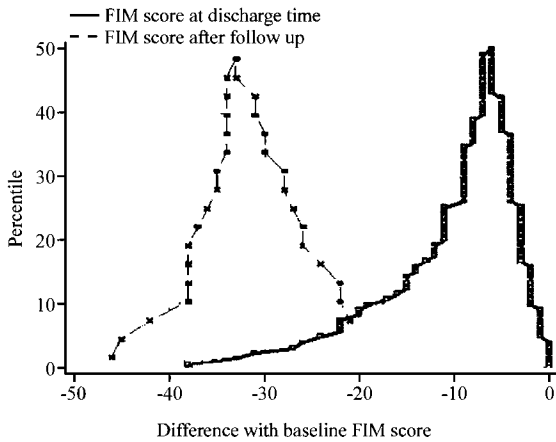| FIM subgroup scores	Total FIM at hospitalization	Total FIM at discharge
Self care	0.78*	0.88*
Sphincter control	0.36*	0.56*
Transfers	0.49*	0.75*
Locomotion	0.58*	0.78*
Communication	0.63*	0.62*
Social cognition	0.66*	0.66*

*p value <0.05

Fig. 1: Total FIM scores in three measurements

Recovery with respect to FIM score was significant in terms of self-care, transfer and locomotion considered as motor subscale altogether. No significant association with respect to FIM score was evident between hospitalization and discharge time in terms of communication and social cognition (9.4±1.1 and 13.8±1.7, respectively).

The correlation between Total FIM score and its subgroup scores is investigated in Table 1.

The mountain plots of percentiles of total FIM scores compared to baseline show more homogenous and better improvement of FIM score after discharge time and during the follow up period (Fig. 1). It is shown that some patients had trivial or no improvement in their FIM score at discharge time, while some others had significant changes in FIM score.

The study shows that FIM score at hospitalization time is an independent predictor of total FIM score at discharge time.

The results of study also showed patients who have been undergone the surgery with DHS had earlier sitting and walking days compared with arthroplasty group (p<0.05).

The study found that there was no correlation between DM and HTN with length of stay, sitting, standing and walking days (p value >0.05).

The multivariate regression analysis showed the age and FIM score at hospitalization time and BMI group to be the independent predictors of total FIM score at the time of discharge. One unit increase in age was estimated to decrease FIM up to 0.19 and one unit higher FIM score at hospitalization time was estimated to increase discharge FIM score up to 0.87. In current study, no correlation among BMI; either totally or categorized in subgroups, FIM scores and other recovery scales at discharge time were found (p value <0.05).

The regression model was able to explain 66% of variability in FIM scores. To compare the effect of above mentioned predictors on FIM score, the model was rerun requesting for standard beta for each predictor which showed best effect for FIM score at hospitalization time followed by age and BMI group, respectively.

DISCUSSION

Data showed only the age and FIM score at hospitalization time to be the independent predictors of total FIM score at discharge. In current study, no correlation was found between BMI; either totally or categorized in subgroups and FIM score at discharge time.

In a research by Vincent et al. (2009) it was reported that BMI did not influence overall FIM scores and functional outcomes after a total hip replacement procedure, but severe obesity was related with excess rehabilitation costs. The same study interestingly resulted that length of stay was 0.8-1.3 days longer in the body mass index less than 252 kg m^{-2}, may be due to a variety of factors such as patient fatigue or poor appetite and anemia.

A reason for this similarity between obese and non-obese patients is that in our study the number of obese patients was low and indeed there were no severe obese patients in current study. But, unlike other mentioned studies, because our experience is cohort, empowers the research.

A retrospective survey regarding the effect of obesity on the outcomes of rehabilitation following hip arthroplasty, concluded that an excessive BMI does not prevent gains during inpatient rehabilitation; however, BMI is related with FIM efficiency, LOS and hospital charges in a curvilinear fashion. On the other hand, these gains are made less efficiently and at a higher cost than those made when the BMI is low (Vincent and Vincent, 2008). What empowers this study compared to ours is that the data were collected retrospectively from three consecutive years, so with respect to its sample size is much more reliable. Other notable issues are dividing

patients to four subgroups and the existence of severe obese patients which makes the study different.

Contrary to the above-mentioned findings, in a study regarding the effect of rehabilitation on total Knee arthroplasty, it was shown that very severe obesity (BMI> 50 kg m^{-2}), advanced age, bilateral TKA, do not negatively affect functional improvement during inpatient rehabilitation.

In a study regarding acute burns, there was a negative association between BMI and FIM. Patients with higher BMI (>25.15) demonstrated lower FIM locomotion scores than corresponding patients with a lower BMI (<25.15) as well as increased age is correlated with lower outcomes in terms of FIM scores (Farrell *et al.*, 2008).

Despite our results, another line of evidence suggests that there is a statistically significant negative association between individuals BMI and relative improvement of the FIM score with respect to patients with stroke. In fact, this study revealed rehabilitation is significantly less effective in overweight and particularly in obese patients (Kalichman *et al.*, 2007).

Supporting the mentioned study, investigators have found that subjects with lower BMI may have better functional recovery (Di Monaco *et al.*, 2006). An important issue between these two studies is that the first one similar to ours used FIM instrument for evaluation, while Di Monaco *et al.* (2006) used Barthel Index, which maybe FIM score uses some tough measures to predict outcome.

Interestingly, contrary to the majority of surveys, a study by Jain *et al.* (2008) reports that in an acute rehabilitation setting, obese patients had higher gains in FIM scores as compared with normal-range-BMI patients. Most of the improvements in FIM scores were accounted for by the motor subscale, with little or no improvement on the cognitive scale. Of note, the prosperity of the survey was its huge number of subjects to be studied, as well as a detailed categorization in terms of BMI.

Similar to Jain *et al.* (2008) median gain in FIM scores from admission to discharge was highest in terms of motor subscale and there was no significant difference for psychological and cognitive subscales. What is clear is that at rehabilitation wards special attention is drawn on locomotion rather than psychological issues.

It is worth mentioning that one of the results in this study was that patients who had been undergone the surgery with DHS had earlier sitting and walking days compared with arthroplasty group denoting that fixation method and fracture region with a few side effects bring about earlier ambulation.

Another powerful aspect of the survey is follow up showing that its FIM score is even higher than FIM at discharge. This means that continued spontaneous

recovery after discharge is even much more effective than that at our services. Of important reasons for short-time rehabilitation at our rehabilitation wards are financial problems of the patients and lack of comprehensive support of insurance companies.

Limited number of patients, especially obese and very obese patients, enrolled in our study may have contributed to generate the inconclusive results.

Another limitation of the study is patients' economic issues which do not let them stay at the rehabilitation ward enough to be studied completely in terms of FIM alterations. In fact, patients are discharged as soon as minimum standing and walking.

Also, the number of patients followed up was limited in the study due to lack of a comprehensive collaboration between the Physical Medicine and Rehabilitation and Orthopedic wards, as the majority of patients do only follow up their surgeons' recommendation.

At last, it is highly recommended that in the upcoming studies patients' IGF-1 (Di Monaco *et al.*, 2009) and even calcium or densitometry are considered as the predictors of FIM scores.

CONCLUSION

The study showed only the age and FIM score at hospitalization time to be the independent predictors of total FIM score at discharge. Elevated BMI has not adverse effect on FIM gains in patients with hip fractures. Simple surgery methods such as DHS revealed earlier recovery time than more complicated procedures.

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