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Predictors for rehabilitation outcome in Asian geriatric hip fracture patients

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ABSTRACT

Purpose. To identify predictors for rehabilitation outcome in Asian geriatric hip fracture patients.
Methods. Records of 153 consecutive Asian patients aged 61 to 99 years who underwent surgery for hip fracture and were followed up for at least one year were reviewed. They were stratified into 4 age-groups: 60–69 years (n=27), 70–79 years (n=70), 80–89 years (n=50), and ≥90 years (n=6). Any comorbidity, regardless of severity, was recorded. Pre-injury and postoperative functional status was evaluated using the 36-item Short Form Health Survey. Relative functional gain (RFG) is equal to absolute functional gain (physical component summary [PCS] score at one year minus PCS score at 6 weeks) divided by the maximum potential gain (maximum PCS score minus PCS score at 6 weeks). RFG of <0.5 and ≥0.5 is defined as poor and good rehabilitation outcome, respectively.
Results. In univariate analysis, age 80–89 years (p=0.026), arthritis (p=0.082), and hypercholesterolaemia (p=0.014) were predictors for RFG. In multivariate analysis, age 80–89 years (p=0.016) remained a predictor for poor RFG, and hypercholesterolaemia remained a predictor for good RFG.
Conclusion. Poor rehabilitation outcome was associated with patient age of 80–89 years; an orthogeriatric approach may be beneficial in optimising rehabilitation outcome in elderly hip fracture patients.

Key words: *aged; aged, 80 and over; hip fractures; rehabilitation*

INTRODUCTION

Geriatric hip fractures are a growing concern in countries with an ageing population.[1,2] In Singapore from 1991 to 1998, the annual incidence of hip fracture in those aged >50 years was 152 per 100 000 men and 402 per 100 000 women.[2] The incidence has risen rapidly over the past 40 years and the trend is expected to continue.[2,3] Hip fractures are associated

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with the highest level of morbidity and mortality, largely due to functional deterioration and potential loss of independence. Therefore, hip fractures impose a considerable socioeconomic burden on society.[3,4] The recovery process also incurs psychological stress for patients and their carers, along with financial costs from hospitalisation and rehabilitation.[3,5]

Treatment for hip fracture consists of surgical intervention followed by intensive physiotherapy and rehabilitation.[3,6] The goal is to return to pre-morbid functional status.[6,7] Preoperative status affects rehabilitation outcome, and the impact of each preoperative predictor can be determined by analysing the patient's functional gain throughout rehabilitation.[6,8,9] Functional status after rehabilitation may affect long-term survival and mortality; optimisation of rehabilitation is thus important.[7]

Identifying preoperative predictors (including age, previous ambulatory status, and fracture type[6–11]) may improve patient counselling and optimise rehabilitation to enable more favourable outcome in terms of quality of living, functional status, mortality, and health care.[10–12] Age is a consistent predictor of postoperative functional status.[8–12] This study aimed to identify predictors for rehabilitation outcome in Asian geriatric hip fracture patients.

MATERIALS AND METHODS

This study was approved by the SingHealth Centralised Institutional Review Board. Records of 153 consecutive Asian patients aged 61 to 99 (mean, 77.04; standard deviation, 7.44) years who underwent surgery for hip fracture at our hospital from June 2011 to early March 2013 and were followed up for at least one year were reviewed. They were stratified into 4 age-groups: 60–69 years (n=27), 70–79 years (n=70), 80–89 years (n=50), and ≥90 years (n=6).

Any comorbidity, regardless of severity, was recorded. Pre-injury and postoperative (at 1.5, 3, 6, and 12 months) functional status was evaluated by technicians and physiotherapists using the 36-item Short Form Health Survey.[13] The survey comprises a physical component summary (PCS) including items of physical function, role function (physical), bodily pain, and general health, and a mental component summary (MCS) including items of vitality, social function, role function (emotional), and mental health.[14,15] For musculoskeletal symptoms, PCS is strongly associated with the bodily pain scale.[15]

Using the Montebello Rehabilitation Factor Score method,[12,16] relative functional gain (RFG) is equal to absolute functional gain (PCS score at one year minus PCS score at 6 weeks) divided by the maximum potential gain (maximum PCS score minus PCS score at 6 weeks).[12,16,17] RFG is more relevant than absolute gain, as it accounts for the maximal potential gain.[17] RFG of <0.5 and ≥0.5 is defined as poor and good rehabilitation outcome, respectively.[12]

Univariate and mulitvariate analyses were used to determine predictors for RFG; a p value of 0.20 and 0.05 was considered statistically significant, respectively. In addition, rehabilitation outcome at each interval in patients with femoral neck fracture was compared with that in patients with intertrochanteric fracture.

RESULTS

The mean absolute PCS score improved at each postoperative interval, except for patients aged ≥90 years in whom the score improved at 3 and 6 months but decreased at one year (probably due to increased frailty). Nonetheless, the one-year score was lower than the pre-injury score (Table 1).

In univariate analysis, age 80–89 years (p=0.026), arthritis (p=0.082), and hypercholesterolaemia (p=0.014) were predictors for RFG (Table 2). In multivariate analysis, age 80–89 years (p=0.016) remained a predictor for poor RFG, and hypercholesterolaemia remained a predictor for good RFG (Table 3).

Compared with patients with an intertrochanteric fracture, those with a femoral neck fracture achieved

Table 1
Mean absolute physical component summary (PCS) score before and after rehabilitation

Age-group (years)	Mean absolute PCS score				
	Pre-injury	6 weeks	3 months	6 months	1 year
60–69	79.79	42.48	58.07	67.04	73.47
70–79	72.83	35.23	45.33	54.14	58.70
80–89	65.78	36.47	43.39	50.28	53.62
≥90	54.38	30.08	52.46	57.00	46.42

better absolute PCS score, absolute functional gain, and RFG at 3 months (p<0.001, p=0.009, and p=0.014, respectively) and at 6 months (p<0.001, p=0.004, and p=0.001, respectively), but not at one year (Table 4).

DISCUSSION

In hip fracture patients followed up for one year, increased age is associated with decreased percentage of successful rehabilitation.[8–12,18] Our study showed those aged 80–89 years had poorer one-year rehabilitation outcome (in terms of RFG) than those aged 60–79 years. This could be due to weakness of the hip muscles secondary to ageing and inactivity.[19] However, patients aged ≥90 years did not have poorer rehabilitation outcome. This could be because such patients had a low baseline level and thus high relative gain. SF-36 is a subjective score; elderly patients with a low expectation of their attainable ambulatory ability may perceive any functional gain as good. In addition, the sample size for this age-group was small.

In our study, hypercholesterolaemia was associated with good rehabilitation outcome. Although the association of lower cholesterol level with frailty and poorer rehabilitation outcome has been reported, the association of high cholesterol with good rehabilitation outcome has yet to be proven.[20] Possible explanations may involve socioeconomic factors, nutritional status, and the effect of concurrent treatment of hypercholesterolaemia on rehabilitation. Arthritis was not an independent predictor, probably

Table 2
Univariate analysis for predictors of relative functional gain

Variable	No. (%) of patients	B	OR (95% CI)	p Value
Age-group (years)				
60–69	27 (17.6)	-	-	0.152
70–79	70 (45.8)	-0.480	0.619 (0.253–1.513)	0.293
80–89	50 (32.7)	-1.120	0.326 (0.122–0.873)	0.026
≥90	6 (3.9)	-0.767	0.464 (0.072–2.976)	0.418
Gender				
Female	103 (67.3)	-	-	-
Male	50 (32.7)	0.423	1.527 (0.765–3.048)	0.230
Comorbidities				
Arthritis	5 (3.3)	1.970	7.170 (0.781–65.812)	0.082
Stroke	16 (10.4)	-0.297	0.743 (0.244–2.259)	0.601
Hypertension	103 (67.9)	0.209	1.232 (0.608–2.499)	0.562
Ischemic heart disease	27 (17.6)	-0.011	0.989 (0.418–2.338)	0.979
Parkinson's disease	6 (3.9)	-20.746	0	0.999
Renal disease	5 (3.3)	0.120	1.127 (0.183–6.957)	0.897
Diabetes	45 (29.4)	0.429	1.535 (0.755–3.121)	0.237
Depression	3 (1.9)	-20.713	0	0.999
Cognitive impairment	8 (7.8)	-0.606	0.545 (0.106–2.798)	0.467
Hypercholesterolemia	61 (39.9)	0.846	2.330 (1.188–4.568)	0.014
Vascular disease	1 (0.7)	-20.692	0	1
Fracture type				
Femoral neck	97 (63.4)	-	-	-
Intertrochanteric	56 (36.6)	-0.227	0.797 (0.401–1.585)	0.518

Table 3
Multivariate analysis for predictors of relative functional gain

Variable	B	OR (95% CI)	p Value
Age-group (years)			
60-69	-	-	0.119
70-79	-0.667	0.513 (0.201–1.310)	0.163
80-89	-1.269	0.281 (0.100–0.790)	0.016
≥90	-0.785	0.456 (0.067–3.083)	0.421
Arthritis	1.855	6.389 (0.658–62.014)	0.110
Hypercholesterolemia	0.990	2.692 (1.323–5.479)	0.006

Table 4
Functional gain in patients with intertrochanteric fracture versus femoral neck fracture

Functional outcome	Intertrochanteric fracture (n=56)	Femoral neck fracture (n=97)	95% CI	p Value
Mean physical component summary score				
3 months	39.3	51.8	5.92–18.96	<0.001
6 months	45.1	61.1	8.50–23.54	<0.001
1 year	54.9	61.6	-1.69–14.86	0.117
Absolute functional gain				
3 months	6.12	13.13	1.77–12.26	0.009
6 months	11.89	22.48	3.48–17.70	0.004
1 year	21.77	22.92	-6.416–8.724	0.763
Relative functional gain				
3 months	0.036	0.196	0.034–0.680	0.014
6 months	0.143	0.402	0.106–0.581	0.001
1 year	0.333	0.385	0.401–1.585	0.518

because age was a confounder for arthritis.

In our subgroup analysis comparing the progress of rehabilitation outcome at each interval in patients with different fracture types, the absolute PCS scores, absolute functional gain, and RFG at 3 and 6 months was better in patients with a femoral neck fracture than an intertrochanteric fracture, but at one year their score was comparable. This is consistent with studies reporting better functional outcome within 6 months in patients with a femoral neck fracture.[9,21,22]

Our study demonstrated the association between one-year rehabilitation outcome (in terms of RFG) and age. This can be used to guide preoperative counselling and targeted interventions. For patients aged 60–79 years, aggressive rehabilitation and physiotherapy should be used. For patients aged 80–89 years, a preventive approach for rehabilitation may be more appropriate, as they may lack the physiological potential to regain their pre-morbid functional level. Nursing facilities and home care support may potentially be needed for this age-group in view of their poorer rehabilitative potential. For patients aged ≥90 years, aggressive rehabilitation is not needed.

One limitation of this study was that it was conducted on an Asian population and findings may not be generalised to other populations. The sample size of the age-group of ≥90 years was small. Occurrence of certain comorbidities such as stroke, depression, cognitive impairment, arthritis, renal failure, and vascular disease was low. Confounders such as socioeconomic status and social support were not accounted for.

CONCLUSION

Poor rehabilitation outcome was associated with patient age of 80–89 years; an orthogeriatric approach may be beneficial in optimising rehabilitation outcome in elderly hip fracture patients.

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DISCLOSURE

No conflicts of interest were declared by the authors.

REFERENCES

1. Melton LJ 3rd. Epidemiology of hip fractures: implications of the exponential increase with age. Bone 1996;18(3 Suppl):121S–125S.
2. Koh LK, Saw SM, Lee JJ, Leong KH, Lee J; National Working Committee on Osteoporosis. Hip fracture incidence rates in Singapore 1991-1998. Osteoporos Int 2001;12:311–8.
3. Lee YH, Lim YW, Lam KS. Economic cost of osteoporotic hip fractures in Singapore. Singapore Med J 2008;49:980–4.

4. Farahmand BY, Michaelsson K, Ahlbom A, Ljunghall S, Baron JA; Swedish Hip Fracture Study Group. Survival after hip fracture. Osteoporos Int 2005;16:1583–90.
5. Wong MK, Arjandas, Ching LK, Lim SL, Lo NN. Osteoporotic hip fractures in Singapore--costs and patient's outcome. Ann Acad Med Singapore 2002;31:3–7.
6. Chin R, Ng B, Cheung LP. Factors predicting rehabilitation outcomes of elderly patients with hip fracture. Hong Kong Med J 2008;14:209–15.
7. Beloosesky Y, Weiss A, Grinblat J, Brill S, Hershkovitz A. Can functional status, after rehabilitation, independently predict long-term mortality of hip-fractured elderly patients? Aging Clin Exp Res 2004;16:44–8.
8. Koval KJ, Skovron ML, Aharonoff GB, Zuckerman JD. Predictors of functional recovery after hip fracture in the elderly. Clin Orthop Relat Res 1998;348:22–8.
9. Koval KJ, Skovron ML, Aharonoff GB, Meadows SE, Zuckerman JD. Ambulatory ability after hip fracture. A prospective study in geriatric patients. Clin Orthop Relat Res 1995;310:150–9.
10. Dubljanin-Raspopović E, Markovic Denić L, Marinković J, Grajić M, Tomanovic Vujadinović S, Bumbaširević M. Use of early indicators in rehabilitation process to predict one-year mortality in elderly hip fracture patients. Hip Int 2012;22:661–7.
11. Kristensen MT, Foss NB, Ekdahl C, Kehlet H. Prefracture functional level evaluated by the New Mobility Score predicts in-hospital outcome after hip fracture surgery. Acta Orthop 2010;81:296–302.
12. Adunsky A, Lusky A, Arad M, Heruti RJ. A comparative study of rehabilitation outcomes of elderly hip fracture patients: the advantage of a comprehensive orthogeriatric approach. J Gerontol A Biol Sci Med Sci 2003;58:542–7.
13. Patel AA, Donegan D, Albert T. The 36-item short form. J Am Acad Orthop Surg 2007;15:126–34.
14. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care 1992;30:473–83.
15. Ware JE Jr, Kosinski M, Bayliss MS, McHorney CA, Rogers WH, Raczek A. Comparison of methods for the scoring and statistical analysis of SF-36 health profile and summary measures: summary of results from the Medical Outcomes Study. Med Care 1995;33(4 Suppl):AS264–79.
16. Jones GR, Miller TA, Petrella RJ. Evaluation of rehabilitation outcomes in older patients with hip fractures. Am J Phys Med Rehabil 2002;81:489–97.
17. Koh GC, Chen CH, Petrella R, Thind A. Rehabilitation impact indices and their independent predictors: a systematic review. BMJ Open 2013;3:e003483.
18. Parker MJ, Palmer CR. Prediction of rehabilitation after hip fracture. Age Ageing 1995;24:96–8.
19. Barnes B, Dunovan K. Functional outcomes after hip fracture. Phys Ther 1987;67:1675–9.
20. Schalk BW, Visser M, Deeg DJ, Bouter LM. Lower levels of serum albumin and total cholesterol and future decline in functional performance in older persons: the Longitudinal Aging Study Amsterdam. Age Ageing 2004;33:266–72.
21. Fox KM, Magaziner J, Hebel JR, Kenzora JE, Kashner TM. Intertrochanteric versus femoral neck hip fractures: differential characteristics, treatment, and sequelae. J Gerontol A Biol Sci Med Sci 1999;54:M635–40.
22. Cornwall R, Gilbert MS, Koval KJ, Strauss E, Siu AL. Functional outcomes and mortality vary among different types of hip fractures: a function of patient characteristics. Clin Orthop Relat Res 2004;425:64–71.